

"BLACK, SWIRLING WATERS SWALLOWED OUR BABY!"

A true experience of GEORGE W. HOYT, Litchfield, Mich.



1. "NO FOREBODING of impending danger warned my wife and me as we walked home from town one night, pulling our two-year-old boy in his wagon," writes Mr. Hoyt. "We were in the middle of a narrow footbridge, spanning a stream, when fate struck.

2. "SUDDENLY A WHEEL came off the wagon, hurling our baby into the black, swirling waters of the river. Luckily I had my flashlight with me. I switched it on as I jumped over the railing. Despite a thorough soaking, that light did not fail me.





3. "ITS BRIGHT, faithful beam disclosed my boy clinging to the branches of a floating tree! Those dependable 'Eveready' fresh DATED batteries helped save our little boy's life. I will never be without them in my flashlight!

NOTE: An "Eveready" flashlight with "Eveready" batteries, will normally continue to burn under water.

(Signed) George ov. Stoyt"

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The "One-Two" Answer on How "All 3" Stack Up!

1 The 1940 Quality Chart shows which low-priced car gives you most size, comfort, all-around value.

2 Take Plymouth's Luxury Ride...see how much pleasure and riding smoothness low price now buys.

TWO-WAY GUIDE FOR CAR BUYERS

I SEE THE
QUALITY CHART
FOR FACTS

2. TAKE THE
LUXURY RIDE
FOR PROOF



Of 22 Important Features Found in High-Priced Cars... PLYMOUTH has 21...CAR "2" has 11...CAR "3" has 8

THIS YEAR, high-priced cars resemble each other in 22 important quality features. But of "All 3" low-priced cars only Plymouth gives you a majority of these features.

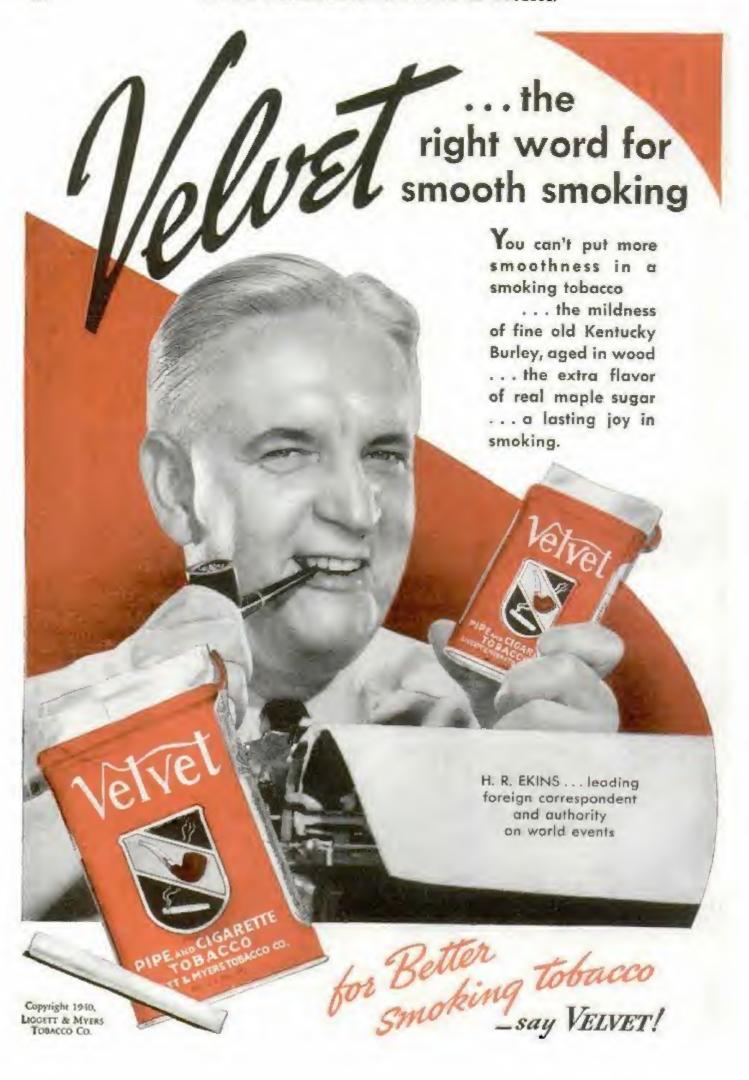
In size, in style, in riding comfort—Plymouth is most like the high-priced cars. See the facts on the Quality Chart. Then take Plymouth's Luxury Ride. And Plymouth is easy to own!



Be sure to see and drive the new lowpriced Plymouth Conmercial Pick-Up and Panel Delivery.

Tunein Major Bowes' Hour, C. B. S., Thurs., 9 to 10 P. M., E. S.T.

PLYMOUTH BUILDS GREAT CARS



Popular Mechanics Magazine

H. H. WINDSOR, Founder

H. H. WINDSOR, Jr., Editor and Publisher

March, 1940

Vol. 73, No. 3

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World's Greatest Chess Game

THE world's greatest chess game is played with battleships and aircraft carriers, heavy and light cruisers, destroyers, mine layers and submarines. It is a game of strategy, of forcing the enemy into action on your terms. In every war that has involved America, the U. S. Navy has been an important factor. Next month Commander Leland P. Lovette of the navy explains the tactics of sea warfare and summarizes the units built and building which make up the well-balanced American fleet. His article is illustrated by eight pages of Coloroto pictures.

Champions in the Making

BOB FELLER learned at Cleveland's training camp that he was taking too long a stride in his pitching. Roy Bell, fielding for the St. Louis Browns, raised his batting average from .250 to .350 on a tip from Rogers Hornsby. Big league baseball is a science, and how it's taught to veterans and rookies in spring training is told in the April issue.

Next Month

YOU run out of superlatives in talking about the Grand Coulee dam. Described in the April issue as "The Largest Thing Ever Built," it is a mile wide, 550 feet high, four times the volume of the Great Pyramid. Railroads, highways, towns and villages are being moved above the shore line of the vast lake it will create, reaching 150 miles up to Canada. Don't miss the story and pictures of this colossal undertaking and the new agricultural and power empire it will open in the northwest.

Golden Fleece, 1940

A NGORA may mean only sweaters, mittens and yarn to you, but it also means angora fur, the Golden Fleece that you can raise in your own back yard. Starting with a \$25 pair of angora rabbits you should have a herd of fifty within a year, and every one of them should produce every year a pound of wool worth three to five dollars. One man with 1,000 rabbits cleared \$200 a month last year. An article next month tells how to run a back-yard wool farm.

Rural Revolution

THERE'S a revolution sweeping American farms. Science, which long ago went to the aid of big grain farmers with heavy power machinery, has at last arrived at the small farm with low-priced tractors and baby combines designed for the 5,000,000 farmers who haven't yet been "sold." Read in April how mechanizing of the farm is even changing crop-growing and harvesting methods.

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Ask Your Dealer to Show You These atlas Features

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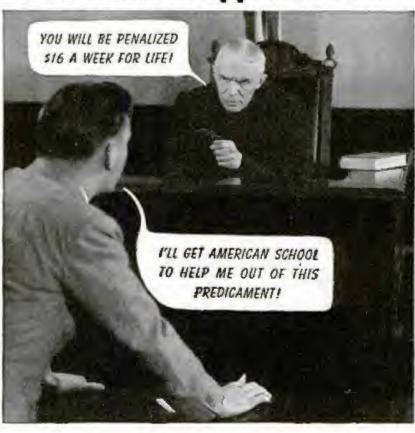
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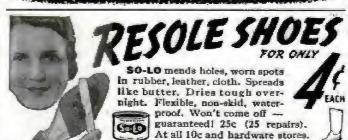
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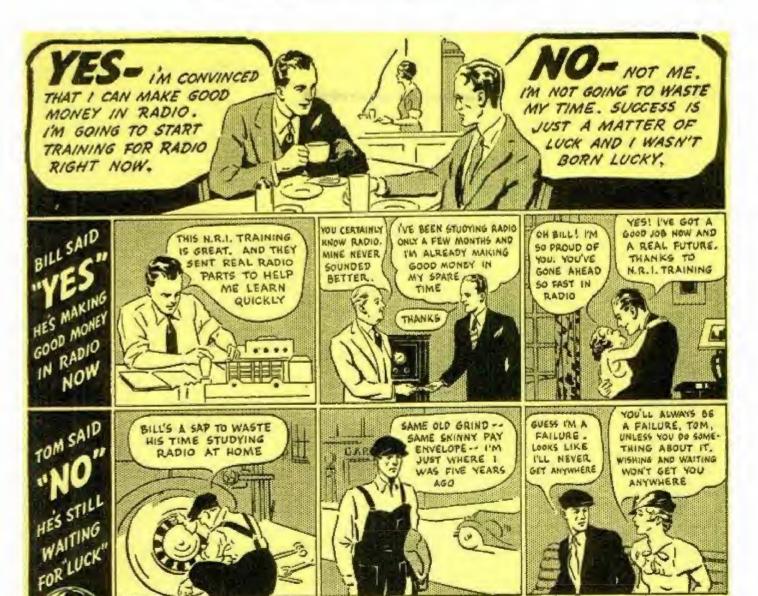
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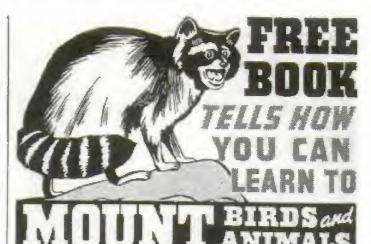
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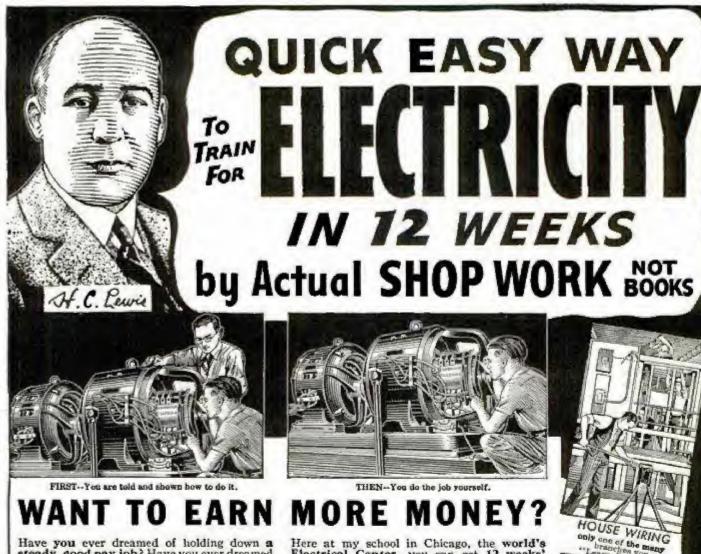
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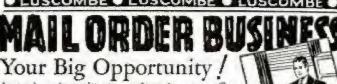
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The U.S. Patent Laws are enacted for your benefitto give you the exclusive right to make, use and sell your invention. But to secure these benefits, it is important to APPLY FOR YOUR PATENT PROMPTLY—because this is a large country and millions of persons have the same opportunity as you to develop an invention similar to yours. Where rival inventors are involved, the law tends to favor the one WHO FILES HIS PATENT APPLICATION FIRST.

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Simple Inventions, Improvements, Often Big Commercial Successes

Inventions need not be complicated to be successful. Many outstanding successes have been made by simple devices. The zipper, thumb-tack, collar-button, safety-pin, paper clip, etc.—and methods of making them—have proved profitable to their inventors. The overall buckle is said to have made a fortune for its inventor. Remember, too, that patents are granted on improvements over already-existing inventions. You can secure a Patent for such an improvement, even though you do not hold the patent on the original invention. Sometimes improvements—as was the case, for example, with the zipper-are more valuable than the original invention. Business is constantly striving

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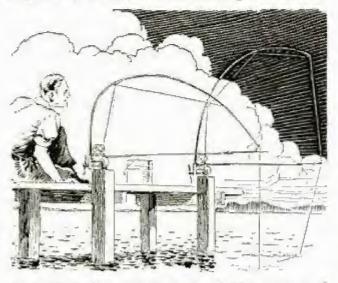
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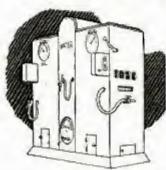


USE of several lines by a single fisherman at the same time would be made possible by a device patented recently. It consists of a holder, which may be attached to boat or dock edge, a resilient rod attached to the holder and a trip device for



engaging the outer end of the rod and holding it in bowed position for fishing. A reel holds the line, which runs through guides to the end of the rod. When a fish bites, the tip of the rod may be disengaged.

WHEN filling-station attendants are too busy to give quick service many a

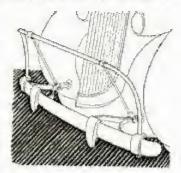


motorist has wished that he might get out and do the work himself. Now comes an inventor with an automatic gasoline station. It includes a container for a meas-

ured supply of oil and gasoline, a piston extending into the container for reducing its capacity and an adjustable sign giving the price of oil and gasoline. The sign and the piston are connected so that when a certain price is indicated on the sign, the piston delivers the proper amount of oil or gasoline desired. Fitting the machine with coin slots would complete the picture. The automatic station also has free water and air hoses.

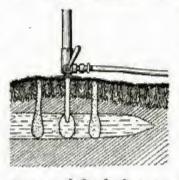
PROTECTION of the lower part of the radiator grille is the objective of a new

patent for an auxiliary bumper designed for attachment to the main
bumper of the automobile. The attachment consists
of an invertedly
arranged Ushaped bar having



its ends positioned crosswise of the main bumper. There are clamping means for securing the ends to the main bumper bar, and brace rods to help support the auxiliary bar above the main bumper and in front of the radiator grille.

RECONDITIONING the lawn would be made easier by a newly patented



method. It consists of preforming a group of holes in the lawn extending from the ground surface to a point below the grass roots. Fluid would be forced under pressure in-

to one of the holes, resulting in the remaining holes being filled with loosely packed soil forming a porous surface conducive to reception and maintenance of moisture.

(Continued to page 33A)

THIS MILLION DOLLAR BUSINESS DRAMATICALLY PASSES INTO HANDS OF LICENSED LOCAL MEN

ONE MAN IN EACH TERRITORY.. ARE YOU THE ONE?

This is the Most Sensational News This Magazine Has Ever Published. It Confirms the Amazing Success of a Revolutionary New Invention That Literally Sweeps Opportunity for Wealth—Not Into the Hands of Capitalists, Big Companies—But to Men of Ordinary Means Who Have the Courage and the Enterprise to Start and Expand a 1,000% Profit Business at Home.

Frankly, this astounding opportunity is for men of ordinary means, but it is not for ordinary men.

You need not even be an amateur mechanic, but you should be mechanically inclined. You must be willing, eager, to study and practice to perfect yourself as an outstanding expert, a specialist in your community. You do not need a great amount of money, because you should begin earning profits at once, but you will need some, as an investment in equipment.

If you can meet these qualifications, this opportunity has the following to offer you-

A business operated from your own home that can pay you \$60--\$76--and more-a day.

A business which will permit you to expand, train others and make your business just as big as you wish,

A business that in the majority of communities has no competition and in every community will capture thousands of ever-present jobs that, because of physical handicaps, existing competition cannot handle.

A business that will be licensed to you by the owners of the PATENTS which only you can use in your territory—and only

you will use this revolutionary invention that suddenly makes undreamed of earnings possible for operators.

WHAT IS THIS INVENTION?

The WARNER ELECTROPLATING METHOD gives you a combined brush and tank method that makes electroplating as easy as painting. Now it is no longer necessary for the family, store, office, factory, to throw away good materials because they are shabby. At last they can be REPLATED quickly at BIG PROFITS.

This new patented invention has changed dramatically the entire picture. Until now, all electroplating had to be taken to a big plant where the investment was enormous and overhead high. In most cases this meant sending the work hundreds of miles away, further expense, and weeks of delay.

Do you begin to get the vision of the big-money opportunity this startling invention has created? You see why it is sensationally capturing a million dollar industry!

There are far more electroplating jobs than plants to do them. The vast majority of towns have no electroplating plants. Many plants are able to handle only the biggest jobs simply because they cannot afford to change liquids in their tanks. Millions of dollars worth of profitable jobs are lost because the expense of disassembling, plus shipping, is too costly or too great trouble.

Think what it means to be able to do just as good electroplating as the big tanks, but with an electric brush! Fascinating work—the actual brushing easy as painting. And, with the marvelous, patented, precious and common, plating compounds, even an inexperienced man quickly can master the work, and do every job that only big liquid tanks, costing the owner thousands of dollars, heretofore could do.

Yet, you can operate in amazingly small space! You can get business from homes, garages, stores, doctors, dentists, hotels, apartments, restaurants, offices, theaters, key shops, repair shops, bicycle shops, hospitals, factories, optical shops, taverns, beauty parlors, individual auto owners. You, when licensed, can have virtual monopoly on this lucrative business in your community.

BIG PROFITS --- NO SEASONAL SLACK

For example, you gold plate rings at a cost of 3 cents each and can charge 75 cents each! Or REPLATE a 26-piece set of silverware for \$15.00, your cost \$3.00. A musical instrument at a cost of no more than \$3.00 and charge \$18.00 to \$60.00! You will be told of others who with this new invention are making enormous profits daily.

A COMPLETE PLANT - FREE TRAINING

You will be given, without extra charge, complete easy instructions showing you exactly how to proceed on any job. With this easy training you can't go wrong. You will be shown where and how to get all the work you can handle. You will receive every single piece of equipment and supplies you need to GUARANTEE AS COMPLETE—PERMANENT—BEAUTIFUL—WORK AS THE HIGHEST PRICED PLANT.

PROFITS IN SURPRISING SHORT TIME

Only licensed operators are permitted to use the COMPLETE patented Warner method of electroplating with a brush. Thus you can quickly enter an unlimited market, with profits of 1,008% and more, and make your business just as big as you want. Write at once for full details of this remarkable Plan, and the Warner new COMPLETE method.

PAY NO MONEY NOW—GET FREE DETAILS

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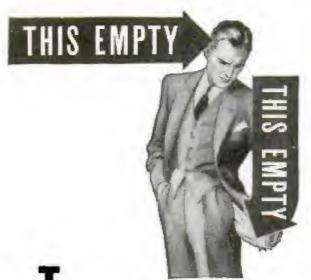
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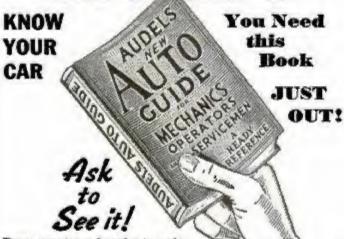
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Nothing can be more fatal to inventive success than procrastination. In a great country of more than 120,000,000 souls; where the inventive spirit is encouraged both by government and by a free, competitive system of barter and trade—it is but natural that often two or several inventive minds may be thinking along similar lines.

WHY ACTION IS IMPORTANT

This may—often does—give rise to complications. Thomas Edison is considered the father of motion pictures. But it is a known fact that a man by the name of Leroy was also an early inventor in this field. Edison was more diligent in taking steps to protect his

rights. The Patent Laws favor the man who is diligent.

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WHAT TO DO FIRST!

Your very first step is to fully inform yourself—KNOW WHAT TO DO. Find out how the Patent Laws can protect you, what steps are necessary to apply for a Patent, what kind of a sketch, drawing or "disclosure" is needed—what other diligent inventors have done to protect themselves. These facts and many more are simply and clearly explained in the FREE books shown on this page. They are yours for the asking. With them you can quickly place yourself on the SAFE SIDE so far as your knowledge of Patent procedure is concerned. The coupon below was put there for YOU! Use it NOW!

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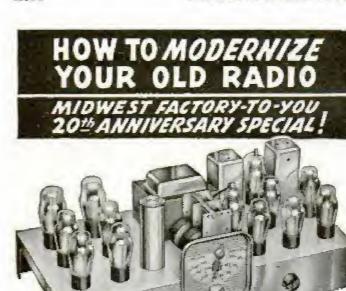
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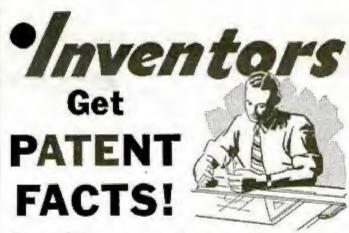
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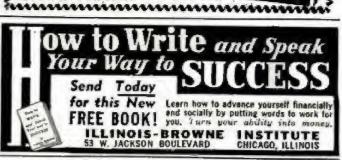
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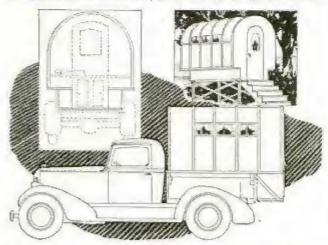
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PAINTERS would find useful a newly patented attachment for paint cans. It



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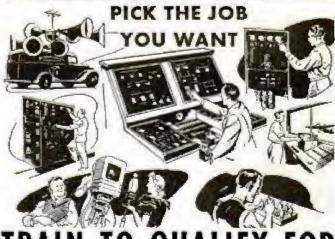
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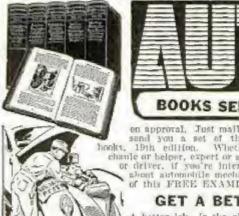


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BIG Money taking orders: shirts, ties, hosjery, underwear, pants, jackets, sweaters, uniforms, etc. Sales equipment free! Experience unnecessary, Nimrod, 4922-BG Lincoln, Chicago.

STEADY Work—Good pay. Reliable man wanted to call on farmers. No experience or capital required, Pleasant work, Home every night. Make up to \$10 a day. Wonderful new proposition. Particulars free, Write McNess Co., Dept. 401, Freeport, Illinois.

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\$1 STARTS You in business selling outstanding line ties, 5c each up: also boxed novelties. Over 100% profit. Wash ties, 60c dozen, sample 7c. Slyde-On ties, \$2.40 dozen, sample 25c. Free swatch book with first order. Write for descriptive whole-sale catalog, prices, free sample materials. Philip's Neckwear, 20 West 22nd. Dept. P-4, New York.

WRITE Quick for amazing new line of men's shirts and sport ensembles. Easiest sellers. Low as 3 for \$2.98. Beautiful San-forized fabrics, exclusive features. Money back gnarantee. Big profits assured, re-peat business. Valuable outfit free, Style-wear. Dept. A-214. Eric. Penna.

POCKET Pal knife and scraper, New best seller. Details and sample 25c. Apex Co. Dakota Bldg., St. Paul, Minn.

BIG Money taking orders; shirts, ties, hosiery, underwear, pants, jackets, sweaters, uniforms, etc. Sales coulpment free! Experience unnecessary, Nimrod, 4922-AN Lincoln, Chicago.

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AGENTS: 200% Profit on amazing new discovery. Cleans, polishes, waxes cars in 30 minutes. Magic all-purpose polish. Instant demonstration sells most skeptical auto owner and housewife. Enduro, 2420-A Grand River, Detroit, Michigan,

AMAZING New product-"Sentinel" pre-vents odors, tastes of one food from permeating others. Keep cantaloupe, fish, on-ions, butter, etc., uncovered in refrigerator, \$1.00 postpaid. Agents wanted, especially Ladies' Aids. M. O. Sales Service, Atkinson, Nebraska.

Ladies' Aids. M. O. Sales Service, Atkinson, Nebraska.

WANTED! Agents to sell nationally guaranteed, popular priced, domestic electric refrigerators, direct to consumer, Commissions up to 50%. Gennett & Sons, Manufacturers, Richmond, Indians.

ALL Sales-people read "Mail Salesman" for successful results; profits; pilaps: ideas; methods, Sample copy dime and 3c stamp. Sidney. Pottsville, Penna.

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EVERY Man and woman is a prospect! No experience or money required to represent world's largest shirt manufacturer selling direct to wearer. One year guarantee: half price offer; customized fit. Full line of sportswear including slacks and ensembles. Hosiery for men and women. Big advance cash commissions and 33% cash bonus writing easy orders, spare or full time. We deliver and collect. Write quick for free money-making sales outfit. Rossellif-Quaker. 1239 Broadway. Dept. 465, New York.

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SCHOOL Seniors—Earn graduation expenses selling our popular name cards, Best commissions. Free cards. Big catalogue. Write Craftcards, Box 235, Pittsburgh. Penna.

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DON'T Be a lob hunter—Start your own business on our capital. No hard times; no lay-offs; always your own boss. Hundreds average \$3,000 to \$5,000 annual sales year after year. We supply stocks, equipment on credit. 200 home necessities. Selling experience unnecessary. Wonderful opportunity to own pleasant, dignified, profitable business backed by world-wide industry. Write Rawleigh's, Dept. CU-PPM, Freeport, Ill.

STRANGE Chemical sponge cleans wall-

STRANGE Chemical sponge cleans wall-paper like magic. Banishes housecleaning drudgery. Sensational demonstration. Samples sent on trial. Rush name. Kris-tee, 116, Akron. Obio.

BUSINESS Proposition resilvering mirrors, autoparts, reflectors, making chipped glass signs. Write Sprinkle, Plater, 128, Marion, Indiana.

AGENTS—Men's suits 84c, pants, 37c, top coats 62c, ladies' coats 52c, dresses 15c, Other big bargains. Catalog free. Roosevelt Mercantile, 566-SR Roosevelt, Chicago.

WINDOW Sign letters. Penny each, large sizes. New styles. Absolutely beau-tiful. Prec samples. Atlas. 7941 Halsted. Chicago.

GET Free food products! Send no mon-cy. Big \$7 value order-getting demonstra-tion kit given to reliable man to start big pay, year 'round business. Earnings start at once. Experience not needed. Ed Mills. 3514 Monmouth, Cincinnati, O.

MAGIC Disc heats water without gas, coal or oil. Tremendous seller. Big profits. Pocket samples for agents, Rush name for free offer. Nuway, Dept. X-163, Des Moines. Iowa.

REPRIGERATOR Purifier, new, fast selling, 100% profits, repeat sales. Details free, sample 25c. Cache Co., Box 728, San Dieso, Calif.

MEDICINE Distributors: 500% profit selling 12-ounce \$1.50 Vi-Co laxative tonic. Exclusive agency guarantees success. Vi-Co Sales, V-11, Birmingham, Alabama.

MYSTERIOUS Disc heats water instant by without coal, gas or oil. Pays up to 178% profit. New principle. No risk sam-ple offer. Write Lux Company, Dept, H-126, Elkhart. Ind.

SELL Merchants wall signs. Cost 1c. ell 10c. Richards, 127-M E. New York St., Indianapolis.

MAKE And sell your own products. No machinery needed. Amazing profits. Guaranteed "Chemist Approved" formulas. Catalog free. Kemico, 10-C, Park Ridge, Ill.

SELL Nip external treatment coughs, colds. Sample 10c, sells 25c, Nip Products. Lamoni. Iowa.

BARGAINS—100 Blades 25c; electric razor 55c; candid type camera 56c; laces, gross 33c; 1001 other items. Catalog. World's lowest priced wholesalers. Mills Sales, 901 Broadway. New York.

MEXICAN Curios sell on sight. Large profits. Free particulars, Samples 10c stamps. Marquez-PT, Apartado 1176, Mexico City.

UP To 500% profit with new perfected 1940 quick action, no flint, automatic gas lighter. Retails 25c. Sample 19c. New Method Company, Box PMG-87, Bradford, Parms.

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YOUR Hose free with outfit. Make up to \$32.50 in a week taking orders for amazing new hostery, Replacement guaranteed against holes, snags, runs. Rush name, hose size. Wiknit. Desk CC-37. Greenfield. Ohio.

neld. Ohio.

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EX-O-LENE Anti-knock power com-pound. More mileage, power, speed, pep. Tremendous profits! Guaranteed! Thermo Exolene, Peoria, Ill.

Exolene: Peoria. III.

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BIG Money—Taking orders for artistic hand-colored \$x10 photographic enlargements in beautiful Deluxe frames, plus free photo mirror. Bend for this unusual proposition. Gibson Photo Jewelry Co., \$31 McDonald Ave., Brooklyn, N. Y.

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Wells, Chicago. III.

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BIG Money selling rugs, Bibles, curtains, Silverware, aluminum, etc. Easy payments, Call or write Highland Merchandising Company, 4624 Woodward, Detroit, 811 Main, Buffalo, 1105 North Saginaw, Flint, 460 South Main, Akron 489 South Main. Akron.

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CASH Profits daily—Nothing like it on market. Large manufacturer has new sensational seller. Patented, third dimension mystery mirroscope sign. Salesmen wanted all cities—sell direct to stores. Cost \$3.00, sells \$7.50. Renneker Co., 347 W. Hubbard St., Chicago.

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ONLY Two sales per day makes over \$1200.00 monthly profits. Auto tools, Every mechanic a prospect, 95% virgin, \$50.00 sales makes \$36.00 profits, New, Proven. Protected territory to producers, Year round demand. Mesco, Beaver City, Neb.

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DISTINCTIVE Letterheads, fine print-

DISTINCTIVE Letterheads, fine print-ing, friendly service, Forest, 202 Ashland, River Forest, Illinois.

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Tested form, 50,000 Press. Lamoni, Iowa. \$1.00 POSTPAID-125 814x11 Twenty pound bond letterheads and 125 634 envelopes. Benneville. 907 West Roosevelt.

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EXCEPTIONAL Value. 250 letterheads, (6x7), 125 envelopes. Name. address neat-ly printed. Fine white bond. \$1.00 post-paid, Kling Press, 7407 So. Western Ave., Let Appeler Coll. paid, Kling Press, Los Angeles, Calif,

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-85c LETTERHEADS labels, statements. Atlanta, Missouri. LETTERHEADS. Envelopes, ls. statements. Paramount 250-21/2×4 Press.

500 LETTERHEADS, Envelopes, statements or billheads \$1.00, 5000 \$7.50, Carter, Box 52, Orange, Calif.

1000 ENVELOPES, Letterheads \$1.66, Samples, American Envelope, 7015 Fenkell,

Detroit.

500 TWO Color stickers, 50c. La Catalog. Cott's Spickard, Missouri.

1000 LETTERHEADS, Envelopes, circu-rs—42.50. Estimates. Quality Printers, lars—\$2.50. Estimates. Quality 317 Scott. Covington. Kentucky.

BETTER Grade printing, free trade illustrations, Reasonable, Economic Press, Leonia, N. J. Leonia, N.

6x9 CIRCULARS—\$1.00 Thousand in quantities, Marcus. 1608 South Lawndale,

Chicago.

1,000 LETTERHEADS \$2,50, Samples
10c refunded. Kingston Press, Kingston.

BUSINESS Envelopes printed 1,000 \$2.50. Darling's, 196 Hudson, Johnson City, N. Y.

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FREE—Card case, prices quality printing (twenty years experience). Acc. 720
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PRINT Anything Reasonable, Samples

PRINT Anything. Reasonable. Samples free. Hamilton Press, 4341P Meade. Chi-

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HAMMERMILL Letterheads, any color paper, ink; 300 8½x11, \$1.48 postpaid. 30 styles type. Free particulars. Woodruffs', 217A Lewis, Duluth. Minn.

1000 NEAT Business cards \$1.00 post-paid. Taft Co., Box 5366, Chicago. 50 SHEETS, 20 Envelopes, 25c postpaid. Western Stationery, Topeka, Kansas.

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Leader, 5130 So, Damen Avc., Chicago.

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Leader, 5130 So. Damen Ave., Chicago.

MODEL Railroad Shop, Dept, PM., Dunellen, New Jersey, 1940 catalog 10c.

CARVED Hull ship model kits. Ship and yacht model fittings; model yacht sails, Illustrated catalog 20c. A. J. Fisher, 1002-M Etowah Ave., Royal Oak, Mich. SPEED! Racing hull construction kits. Free literature. Enclose 5c for mailing. St. Louis Model Boat Co., Clayton, St. Louis, Mo.

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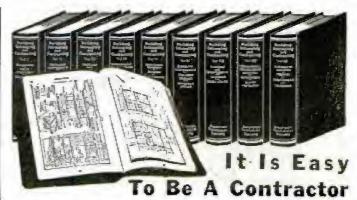
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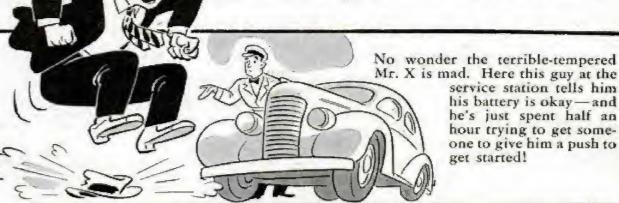
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Popular Mechanics Magazine

WRITTEN SO YOU CAN UNDERSTAND IT

Vol. 73

MARCH, 1940





CCIENTISTS have speculated for years on the things they could do if they had a machine that exerted limitless pressure. One daring thought is that with enough compression they could squeeze a substance so tightly that atomic motion would stop and its temperature would drop to absolute zero.

Whether or not they will ever be able to do that, they are already using great pressures to accomplish things impossible in the past. "Squeeze" has opened up a brand new field in the realm of metallurgy. Met-



Left, blowing smake through powdered-metal filter; right, circuit breaker with disks of powdered metal, and inspecting lamp filaments under magnifier



cuit breaker every time a connection was made.

Powdered copper and tin are compressed into the so-called "oilless" bronze bearings by the new method. When the powdered particles are fused together at high temperature the metal is made porous and may be impregnated with oil up to thirty-five per cent of its volume, resulting in self-lubricating bearings. The oil oozes directly from the pores in the surface of the metal.

als and non-metals are combined. Metals that wouldn't mix in the past are being alloyed. Bi-metals, porous metals, metals that are magnetic in desired areas only, and other unusual structural effects are produced.

The secret of this new art is the use of powdered metals that are compacted under tremendous pressure into useful shapes. The metal is reduced to powder so fine that it passes through a 200 or 300 mesh screen and is molded in hydraulic presses under

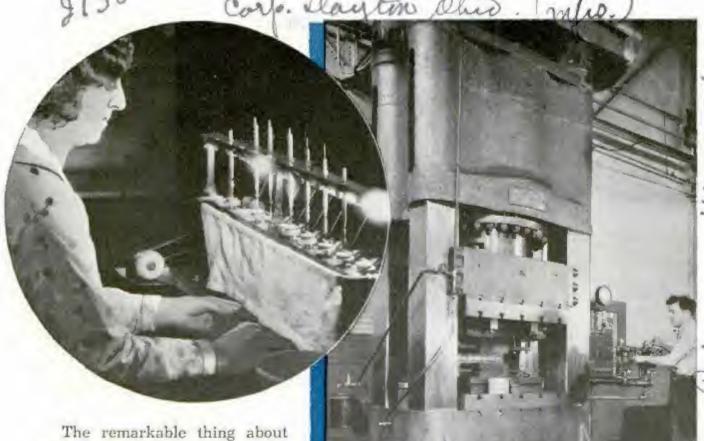
five to 100 tons per square inch.

A handful of iron dust, placed in a press, comes out as a finished oil pump gear, accurate to a thousandth of an inch. Copper and tungsten powders, mixed together, are compacted into switch points that have the high conductivity of copper and the resistance to fusing and wear of tungsten. Copper-silver-tungsten disks only an eighth of an inch thick protect switch points on the 132,000-volt power line between Boulder dam and Los Angeles and deliver perfect service under conditions that would burn half an inch of metal from the contacts of a copper cir-



Top, pressing powderlike tungsten into bars. Center, tungsten oxide heated in hydrogen atmosphere in retorts becomes tungsten powder. Bottom, compressed powders of tin (white) and copper (dark) before sintering; on opposite page, after sintering

31382 POPULAR MECHANICS Seneral madors
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The remarkable thing about powder metallurgy is that at no stage are the materials heated to liquid state; thus many of the difficulties in making castings are avoided. In fact, some gears in the Oldsmobile are made of iron that was never molten at

any stage in its history. This iron is mined as an oxide in Lapland, deoxidized and crushed to fine powder in Sweden, brought to this country and pressed into gear shapes without ever being subjected to the blast furnace.

(Continued to page 149A)



Top, boring diamond dies for drawing tungsten wire; right, 4,000,000-pound hydraulic press; below, fine tungsten wire stronger than steel is drawn from reels at left through gas furnaces and diamond dies



POPULAR MECHANICS Court

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Fish Mounted on Aquaplane Is Carved of Florida Cypress



From a distance you'd think this aquatic cowboy was riding a fish's tail. The fish, however, is a bit of sculptured cypress on an aquaplane

Something new in aquaplane riding was introduced in Florida this season when a swimmer climbed on the back of a fish and then drove it across the waters of Biscayne Bay. The fish, however, was homemade. The aquaplane rider had

mounted the figure of a large fish, fashioned from Florida cypress and painted in vivid colors, on his board and attached his lines to the jaw of the fish.

Engine Vibration Studied

To test the vibration of locomotive wheels at high speed, engineers drive into a greased stretch of track at normal speed, open wide the throttle and let the drivers spin on the slippery rails at a terrific rate. With each revolution vibration sets in, due to the difficulty of keeping the wheels in balance. A motion-picture camera mounted below the cylinders on the locomotive obtained photographs which showed that, in some cases, the wheels go through a pecases, the wheels go through a

riodic lifting, actually leaving the rails and then coming down with a bump. The camera reveals the speed at which vibrations occur and the heights to which the wheels are lifted off the track. For one locomotive bouncing occurred at a train speed of sixty-six miles an hour and with a slip speed on the wheels of 108 miles an hour.

Basketball Players Taught Strategy on Tiny Court

Tiny cut-out figures of basketball players, moved about on a miniature court, help one coach in explaining new plays to his team and in illustrating points of strategy. During pre-season practice, his men use the model to study their relative positions for executing certain defensive and offensive maneuvers.



Basketball coach demonstrating strategy of game to players by using cut-out figures of men on miniature basketball court

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Magnets Move Armies on a Canvas Battlefield

European war battles are being fought in advance on a battlefield of canvas, thirty feet square, over which miniature armies, supply trains, guns, tanks and airplanes are maneuvered by unseen magnets. This indoor theater of war is used to train young soldiers, air pilots and naval recruits in the fundamentals of military tactics, and was invented by Lieut. Coll D. D. Haskard of the British defense research staff. Green canvas is used as a base for laying out a contour picture of any given battle area, woods and trees being cut from rubber; farms, churches, houses, railroads and highways following exactly the details found on aerial maps. Magnets below the canvas move the trains, guns and troops over the terrain. A miniature smoke-maker projects puffs of smoke upward through the canvas to simulate shell bursts or smoke screens.



At right are views from gallery of school where British recruits learn tactics from maneuvers of armies on contour map thirty feet square. Left, projecting smoke through map from beneath to simulate bomb

Super-Fuels for Auto of Future May Double the Power

Automobile engines of the future, burning super-fuel of 100 octane number and having about twice the power for the same size as today's engine, are foreseen by Frank A. Howard, president of the Standard Oil Development company. An engine half the size of those used today would produce at least equal power, and the

mileage per gallon would be twice the present average. The super-fuel already is here and has made possible much better performance and higher efficiency of airplanes. These results, it is believed, can be achieved for motorcars by redesigning power plants to effect small displacement, high compression and supercharging.

Droadway

Bike with Handlebar Saddle Is Easier to Mount



Bicycle with small wheel in front and handlebars mounted beneath saddle is easy to mount and control

Somewhat in reverse of the old-fashioned high-wheel bicycle is a new design introduced in Italy. Here the larger wheel is in back and the small wheel in front, while the rider sits between the handlebars which steer from the back. It is claimed that this type of construction permits easier balance and maneuverability.

"Plastic Shell" Airplane Body Has No Rivets or Seams

Airplane bodies are being made by a new plastic process which eliminates ex-



Plastic body and wing covering for airplane permits high-speed mass production to meet need in wartime

posed rivet heads and seams common in metal construction. The body is strong enough, in the case of a training ship, to accommodate engines ranging from 125 to s 225 horsepower without extra stressing. The fuselage is shaped in two half sections; and these are united into the structure in a manner that forms a one-piece shell. They are made of spruce plywood whichhas been impregnated heavily with phenol formaldehyde, a substance similar to Bakelite. When subjected to a secret process of applying heat and pressure these plywood? sheets become plastic to the extent that \$ they can be stamped out in the desired shapes and then molded into the exact form required to fit the body of the ship. Covering for the wings, likewise, is formed of two molded halves which are fitted over plywood spars and ribs, and bonded and sealed at all points of contact by the same plastic material. In an emergency, mass. production of military planes would bepossible, and if wings or body are damaged by rifle fire or shrapnel they could be repaired quickly on the field. Even for major? repairs a complete shop is not needed.

Sealed-Beam Lamps for Old Cars Are Installed on Bumper



"Driving" and "passing" headlamps of sealed-beam type mounted on bumper to supplement old lights

Owners of cars prior to the 1940 models can obtain the benefit of the new sealed-beam headlamps in use on the new cars. These lamps contain the lens, filament and reflector in a single permanently sealed hard glass unit. When used on old cars, the lamps are designed to supplement those already on the automobile, and their installation involves no changes in wiring

nela Park Christano

POPULAR MECHANICS

systems, batteries or generator capacity. Two auxiliary lamps comprise the unit, one being the "sealed driving lamp," and the other a "sealed passing lamp." Mounted on the bumper, they are wired to the car's upper and lower beam circuits, respectively, so they will operate in conformity with the regular system. So the driver may turn off the auxiliary lights when driving on lighted city streets, they should be wired through a separate switch. Adaptation of the standard sealed-beam system, as used in 1940 models, would call for more powerful generators, rewiring of the car, new switches, or a relay mechanism, as well as special adapters for mounting them.

Self-Dumping Sugar-Cane Truck Stays Level on Rough Road

For use in the sugar-cane fields of the Hawaiian Islands, a self-dumping truck which can empty its load directly into a freight car has been designed and built in Seattle, Wash. It will act as go-between from the fields to railroad cars. The wheels are mounted in seesaw fashion so the body will not tilt if one wheel rides over an obstacle or drops into a hole as it cruises along the rows of cane. Weighing 13,500 pounds empty, the truck holds four tons of cane in a level load. Power delivered through a chain drive comes from a six-cylinder engine of ninety-five horsepower.

Life Jacket Distress Signal Lights When in Water

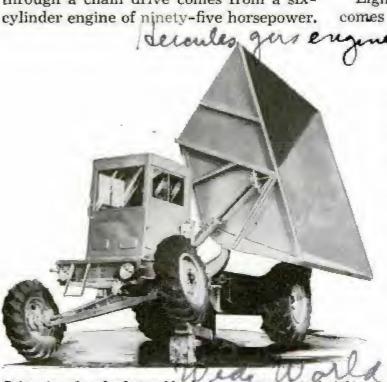
rumph



Distress lamp on left shoulder of life jacket and shown in inset, upper right, burns when in water

Lighting automatically as soon as it comes in contact with water, an electric

distress signal lamp worn on life jackets increases the chances of rescue for shipwrecked victims. Fitted into the shoulder, the electric light gets its current from a zinc tube with a carbon rod center that becomes actuated upon immersion in water. There are no switches and its operation is positive. The cell does not deteriorate or lose its energy in storage, and the light will burn continuously for seventy-eight hours either in salt or fresh water. Other models may be snapped on any life jacket for use during hazardous work about a boat. One unit for ring buoys may be adjusted to burn with great intensity for a few hours, or for a long period with less brilliancy.



Driver in cab unloads truckload of sugar cane into freight car by tipping body. Note truck remains level with wheel raised

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CAMERAMAN



I COVERED the fall of Warsaw. Strangely enough, in this most dramatic siege in all modern history, I had no competition, for all the other American newspapermen and photographers and even the embassy staff and the Polish government itself had left the city two days before I came barging in, on September 7, from

Rumania, in probably the last train that entered Warsaw.

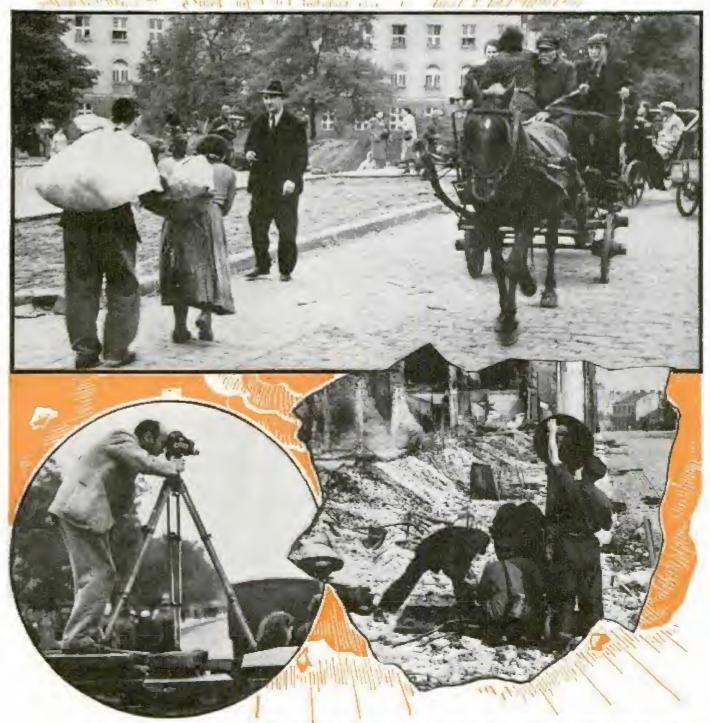
There was nothing particularly brave about my venture. None of us on the train had any idea of the seriousness of the situation until we reached the beleaguered city. After the first moment of horror, when I found myself trapped in a city un-

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Cameras. Osell and Howell.

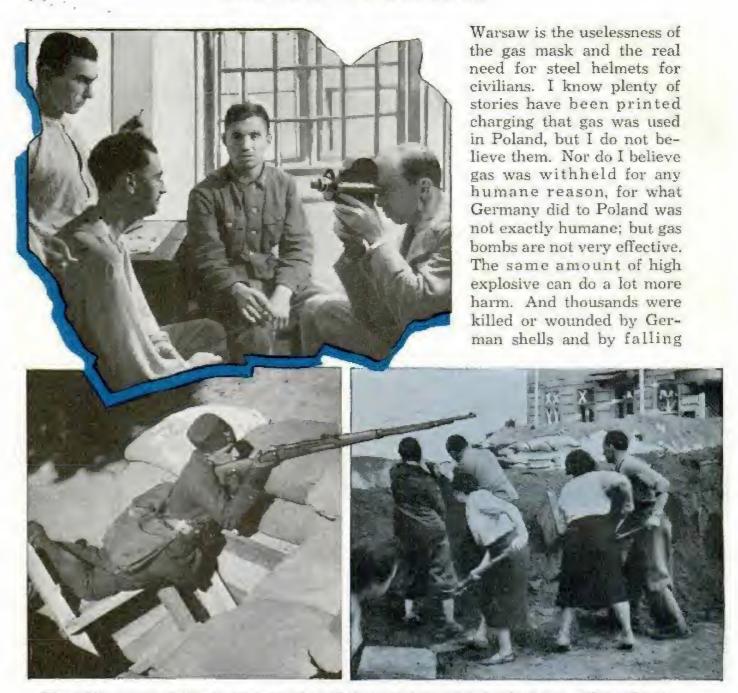
at the FRONT



Refugees from bomb and shell flee afoot and in wagons, top, with few belongings. Below, Mr. Bryan films street scene as emergency crew, right, strings temporary telephone lines

der bombardment, I began to realize what a magnificent opportunity this was. A great siege, sunny weather, no rival cameramen about. But there was a slight hitch -the photographer and his pictures might never get out.

Covering this war with a camera is nothing like the last. As a boy of seventeen I took pictures at the French front for seven months, and drove an American ambulance attached to the French army near Verdun and Argonne Förest. I saw enough there; the "blitzkrieg" in Poland was infinitely worse. In 1917 there was an established front; I knew exactly the demarcations of the trenches, and in quiet periods, for days and weeks, I moved about freely with my camera, and on bright days suit-



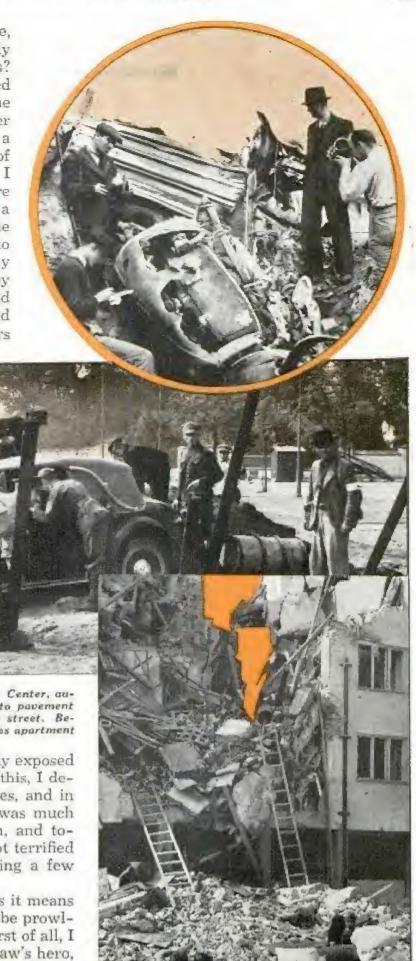
Top, taking movies of German prisoners who said they were "forced" to bombard city. Below, rifleman at entrance to dugout, and women helping civilian men prepare barricades across street

able for pictures I would spend many hours in the first and second line trenches. But in Poland we had no such defenses. Each night the lines changed, the enemy came closer. Toward the end the shell fire seemed constant. Again, the war of 1914 was basically between two armies and probably ninety-five per cent of those killed by arms were soldiers. In Warsaw and in Poland it was a total war, not merely aimed at soldiers but at the entire population, and my estimate would be that far more civilians were killed than soldiers.

One lesson that London and Paris—and Los Angeles and New York, if war should ever reach these shores—must learn from fragments of Polish anti-aircraft shells compared with hundreds hit by bombs. The people of Warsaw had gas masks but did not wear them. They needed helmets to protect them from flying steel. And, to the common people, the incendiary bombs were worst of all. Fires set in crowded home sections nightly burned ten to twenty blocks, rendering thousands homeless.

Plenty of romantic stories have been told of the fearless war correspondents and photographers who leap merrily from one trench to another to get eye-witness stories and pictures. They are not exactly true. All of us in Warsaw were afraid, soldiers, civilians and your photo correspondent. Why wouldn't we be, with bombs dropping constantly and shells raining in the streets?

Still, you do get somewhat used to working under fire. During the first few days I dashed for shelter during every air raid, and spent a good bit of time in the cellar of the American embassy, Then I discovered I was actually more frightened when I stayed with a lot of other scared refugees in the dim-lighted basement. I began to notice that the cook, terribly frightened, forgot her fear by working like a demon. The old janitor kept plugging away at odd jobs. The telephone operators

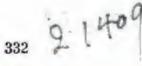


Filming wreckage of fallen bamber, top. Center, automobile placed between rails driven into pavement forms anti-tank barrier across Warsaw street. Below, bomb of delayed-fuse type demolishes apartment

never left their posts, dangerously exposed high up in the building. Seeing this, I decided to try to get a few pictures, and in the two weeks that followed I was much happier when busy in the open, and toward the end was excited but not terrified as I filmed bombers power-diving a few

hundred yards away.

Without the best of credentials it means arrest and execution as a spy to be prowling around a besieged city. So first of all, I went to Mayor Starzynski, Warsaw's hero. who gave me an interpreter, a captain and a camouflaged military car. As I waited in his office an air-raid alarm sounded; look-





I "covered" every section of Warsaw with my three "still" and two movie cameras, and what I saw there is what you would live through in Cleveland, for example, if that city—about the size of Poland's capital—were devastated by artillery and bombing planes. I learned

to recognize the effect of shell, of delayed-fuse bomb, machine gun and incendiary. One of the first days, we drove to the banks of the Vistula, where they were dropping a hundred bombs a day on each of the bridges. The business of photographing thirty-foot bomb craters near the bridge approach was interrupted by four grim-looking Polish soldiers, who guarded me with bayonets for an hour while our papers were checked to make certain we were not spies. Meanwhile I had the opportunity to see the bridge itself, punctured in

many places by five to ten-foot holes where the big bombs had crashed through. But these delayed-fuse bombs, which are intended to penetrate a five-story building and then explode with shattering effect five seconds after the first contact, tore

ing out the window I counted forty-two German planes. Starzynski's only comment was that I should not expose myself at the window. He himself stood only six feet away. Two bombs did land barely thirty yards away, another hit one end of our building.

(Continued to page 155A)

POPULAR MECHANICS

Navy Amphibion Requires No Beaching Crew



Efficient on land and water alike, the navy's new flying boat is equipped with tricycle landing gear which can be lowered in water for beaching on sloping shore without aid of outside crew

Said to be the world's largest amphibion, a new Consolidated airplane ordered by the navy is a twin-engined flying boat with retractable landing gear of the tricycle type. Because its efficiency on water has been extended to land, the ship has a much larger field of operations. It is especially capable of handling itself in remote regions where aircraft tenders and good airports are not available. In water, the landing

gear serves as a sea anchor, assisting in control of the ship on rough open water, and turns are achieved with less skidding. No beaching crew is needed, since the plane can climb a ramp or sand beach under its own power, and launch itself in the same manner. In order to eliminate resistance in the air, the nose wheel, when retracted into the bow, is enclosed completely by hatches that operate automatically.

Gasproof Suit for Air Raids Packs into Lady's Handbag

Made of oiled silk, a gasproof suit that can be packed into a pouch and carried in a handbag offers protection from gas to a person caught in an air raid. Covering the body completely from head to foot, the protective outfit consists of hood, blouse, trousers, gloves and "boots." The suit can be slipped on in three minutes.

¶It takes a year to eighteen months after a railroad tie is ordered before it can be seasoned, treated with preservative, and made ready for laying.



Left, removing gasproof suit from handbag. Right, three minutes later wearer is covered completely from head to foot for air-raid protection

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100,000

-MILE

ONE of the dreams of the automotive engineer—tires that will last as long as the automobile—seems on the verge of coming true. Already a tire good for approximately 100,000 miles in truck or bus service has been created and manufacturers are hard at work on experiments aimed at production of a similar tire for your car.

In the early days of the automobile, owners considered themselves lucky if a set of tires lasted 3,500 miles. Today, owners grumble unless they get 25,000 miles and there are instances in which tires have given 50,000 miles in ordinary service. Since piling up mileage rapidly—before the tire ages—seems to be one of the secrets of success with the 100,000-mile truck or bus tire, the answer may lie in a com-



Taking temperature of tire in test at Mohawk plant (top); section of tire run 109,000 miles without recapping or retreading (bottom, left), and Ruoroscope test to find how tires break down

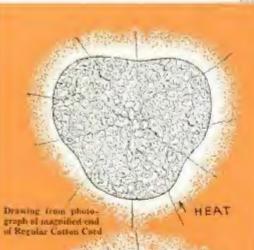
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Above, comparison of ordinary and heat-resistant cords.

Right, testing tensile strength of heat-resistant cord. Bot-

tom, removing cord after heat test in Mohawk plant

bination of fabric and rubber that will resist rapid aging—a tire that will be almost as lively and as resistant to cracking at the end of four or five years as it was at the start of service.

Among the latest developments indicating that the "life-time" tire may be just around the corner for the auto owner is a cotton cord that retards generation of heat in the tire and holds down the "growth" of the tire—the two principal enemies of tires. Running under heavy loads at sustained

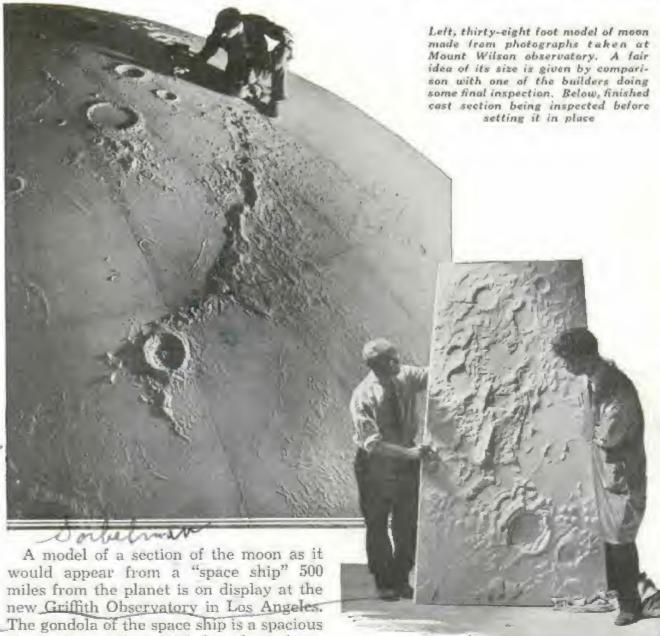
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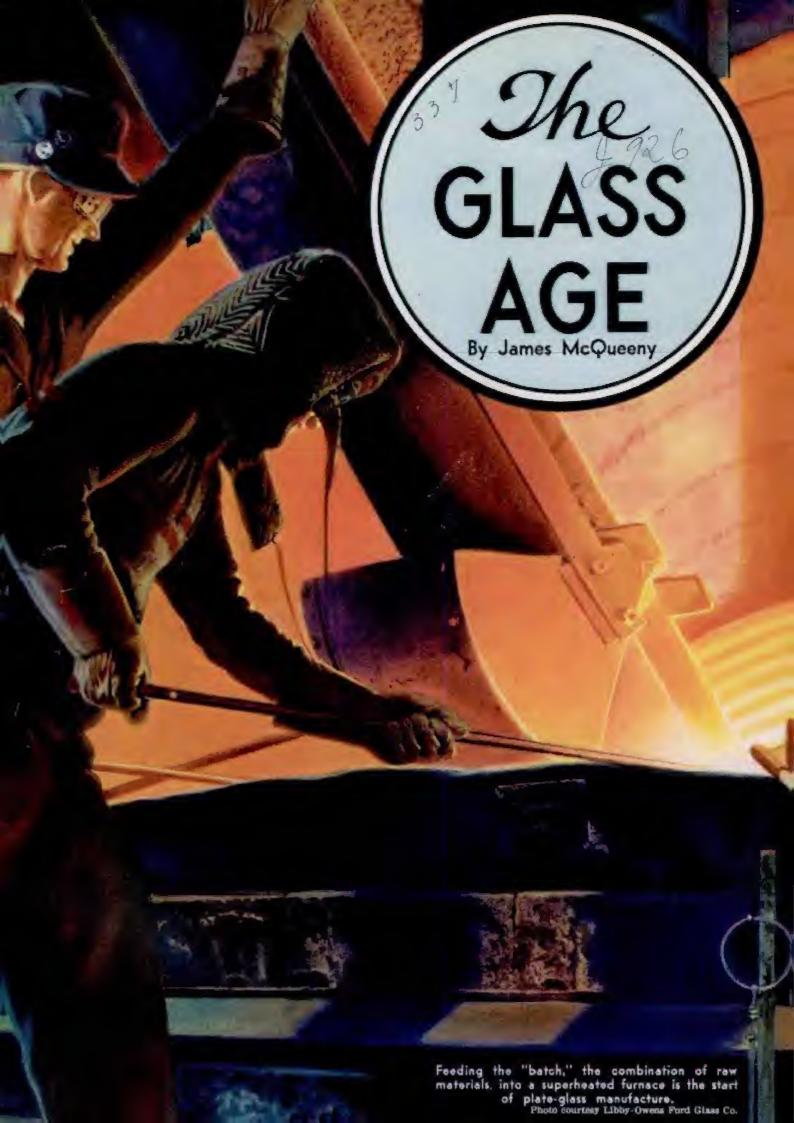
'Trip to the Moon' Offered by Sculptured Map



observation gallery with broad windows, and the moon is represented as a model made from photographs taken with the 100-inch telescope at Mount Wilson, covering an area that extends from the equator to fifty degrees north, which was chosen as being the most interesting and varied. Built to scale, the model measures thirtyeight feet by nineteen feet. Some 650 features have been charted, including the great craters, steep and weird peaks of the lunar mountains, and many valleys, hills and the so-called seas. Sunrise and sunset, with various gradations of the lunar day, are produced by a light moving overhead in a circular track. Construction of the exhibit required the cooperation of an architectural designer and amateur astron-

omer, and a sculptor who worked out the details of modeling and casting. spherical body was divided into gores, each shaped in relief separately and supported by adjustable legs so it could be lined up exactly with its neighbors. From these were made plaster molds that were used in producing the final castings, consisting of cement reinforced with metal lath and channel iron. Fitted together like a jigsaw puzzle with joints "pointed" until they vanished, the castings form an unbroken surface. To heighten the effect of the lights and shadows on the surface of the moon model, it has been painted in tones of bluish gray.

Onel ly Ologer Stylward





Claw of steel, operated by overhead crane, reaches into oven for pot of white-hot glass after terrific heat has fused ingredients into a molasses-like liquid.

LASS, the dictionary says, is a hard, transparent, brittle substance, made by fusing sand with other ingredients. Modern seience doesn't agree with this definition, however, for it has developed a glass as soft as silk, another as strong as steel, and a third without a trace of silica.

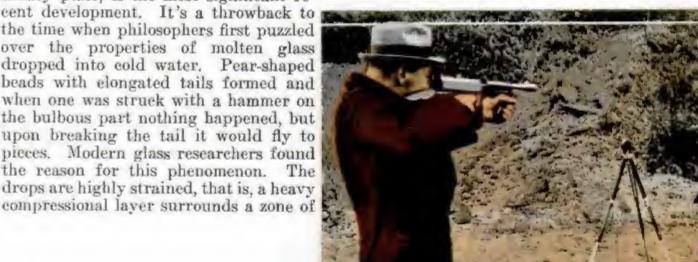
Just when glass seemed to be at its maximum development a few years ago, the industry put on its seven league boots of research and stepped into a score of new fields. As a result, the present uses for glass defy classification.

A glass having four times the strength, yet with four times the flexibility of ordinary plate, is the most significant recent development. It's a throwback to the time when philosophers first puzzled over the properties of molten glass dropped into cold water. Pear-shaped beads with elongated tails formed and when one was struck with a hammer on the bulbous part nothing happened, but upon breaking the tail it would fly to pieces. Modern glass researchers found the reason for this phenomenon.

great tension. Their strength is traceable to this distribution of internal stress.

Applying the same principle in the making of tempered plate glass wasn't so easy. The major difficulty lay in controlling the heat in processing. An electric furnace was the answer to the glassmaker's prayer because with it the prepared glass could be subjected to rapid heating under scientifically regulated conditions and quickly chilled in the air draft of the prescribed coolness.

What actually happens when glass is tempered is that the outer surface, being suddenly chilled, contracts more rapidly than the inner part. Thus, when the







Shortly after the turn of the century, Edouard Benedictus dropped a bottle on a hard floor. There was a resounding crash, but the glass fragments did not scatter. He examined the bottle, found it had con-

tained collodion which had gradually evaporated until the bottle appeared empty. The thin "skin" of collodion on the inside of the bottle held the broken pieces together. From the accident came the idea of joining two pieces of glass with a sheet of nitrocellulose, the beginning of safety glass.

With the recent perfection of a plastic binding known as polyvinyl acetal resin for the inner layer of the glass "sandwich" has come the greatest of all safety glasses. Not only have the faults of earlier laminated glasses been eliminated in the new product but it also has been given four times the resistance to pene-

zero, and unlike other plate glasses, the new one does not grow brittle in winter. The dangers of being cut by flying glass are minimized, for when tempered plate does break it shatters into small, blunt-

edged pieces.

The major difference between Herculite as it's called, and other flat glasses is that it must be fabricated to order from plates, which have been prepared as to size, edgework, holes, and notches. Any attempt at cutting casehardened plate glass results in fragmentation. Fireplace shields, glass-cooker doors, and furnace peephole lights are a few of the noteworthy applications, but in aquari-



Modern use of glass makes houses roomier, living more convenient, homes more attractive . . rentable . . salable.

This house, planned for the readers of Good Housekeeping Magazine, is a joy to live in. These illustrations show only a few suggestions how glass can be used as part of your building or decorating plan to make rooms more spacious and attractive, to make home duties less work, to make any home more rentable more salable. For many other suggestions about glass in modern houses, phone your local Libbey Owens Ford Glass Distributor—listed in the classified section of your phone book.



Glass.

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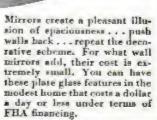
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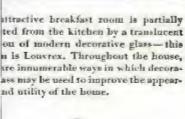
cults you'll achieve. T panel between the close a full-length mirror. Th length mirrors on the de ample angle views. The are made of L.O.F Polis

ainscoting in this bathroom relite-the colorful strucglass. Impervious to edors isture, its colors never fade, se its beauty is permanently I the places it can be cleaned i few strokes of a damp cloth mois. See samples in a wide of colors and combination ers, displayed by your local Glass Distributor.



Mirrors create a pleasant illu-





live in the cold weather zone, storm nd storm doors will reduce your fuel s much as 30%, climitate fogged and I windows, and greatly increase home rt. They generally will pay for themin two or three winters.



IBBEY · OWENS · FORD **UALITY GLASS PRODUCTS**



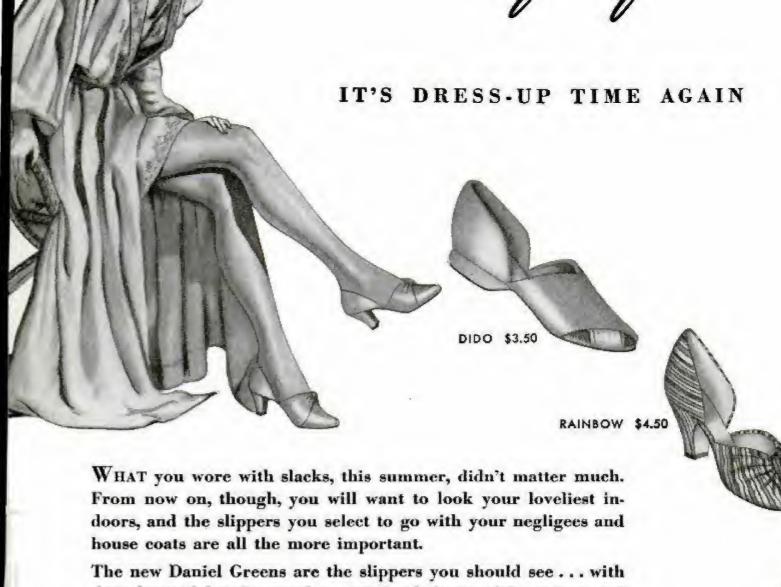
TUNE IN!

"DESIGN FOR HAPPINESS" over CBS stations coast-to-coast, Sunday afternoon at 5 P.M. E.S.T. It's family entertainment for the American family. For other suggestions on Uses

of Glass, allow us to send you

OUR BEAUTIFUL COLOR CATALOG IT'S FREE!

LIBBEY-OWENS-FORD GLASS COMPANY, TOLEDO, OHIO



The new Daniel Greens are the slippers you should see . . . with their beautiful styling and materials, their exquisite colors and workmanship. . . . A pair or two of them will add a Park Avenue touch to your wardrobe at a reasonable price.

Leading shoe stores and departments everywhere have Daniel Green slippers. Always look for the name on the sole. It's your guarantee.... DANIEL GREEN COMPANY, Dolgeville, New York.





tration by impact and five times the elasticity of its predecessors. When broken by hammering, the glass can be rolled into a rug without any of the pieces pulling loose from the binding.

Bullet-resisting glass for bank cages, armored cars, and police vehicles differs from safety glass only in the number and thicknesses of the glass layers and plastic sheetings. Three to five pieces of polished plate with strong plastic material between layers are assembled into one solid piece by heat and pressure. The flexible plastic sheetings are not cushions to absorb the force of the bullets, as you might suppose, but rather confining walls for the thick glass cores, which owing to their mass and hardness, do most of the bullet stopping. Usually, the first bullet does not penetrate the outer layer



Row of revolving grinding and polishing wheels used in glass making (top) and a heavy automobile resting solely on two plates of Herculite, supported in two different ways, thus demonstrating the great strength of this tempered glass. Note slight bend of the glass, both at front and rear, under the car's weight.

Pettaburgh Plate Island Co

of glass and plastic but pulverizes the glazing directly adjacent to the point of contact. The stress the impact places on it is transmitted through the successive layers in the form of a cone, showing up on the opposite side in a small

ring of cracked glass.

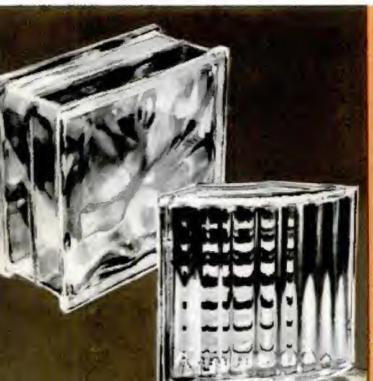
The versatility of glass has captured the public's imagination almost overnight. More of it is being used in our homes and buildings than in the heyday of Venetian glassmaking. A striking example is the new \$2,000,000 Museum of Modern Art in New York which has a long facade almost entirely of glass—the first floor plate glass and metal; the second and third floors walled entirely in Thermolux, a new glass never before used in this country. Wide phorizontal bands of windows are used on the two office floors above and the entire front of the penthouse is plate glass.

A sandwich of spun glass between two sheets of clear glass, Thermolux was selected to wall the museum because it has only about one-third the heat conductivity of clear glass; because of its sound reduction properties, and because of its qualities of light diffusion and distribution. It transmits light farther into the room than does clear glass, yet the light is easy on the eyes and evenly illuminates objects without deep shadows or sun patches.



347 Glasslike "Lucite" being used in dental tool (above). It transmits light from one end to the other, or around corners. Two glass blocks (below, left) used in the building trade. Glastone slab (below, right) with detailed diagram showing manner in which Vitrolite facing is anchored to haydite block. A structural masonry unit in colored glass, it is expected to find wide use in building,

making possible new architectural designs.



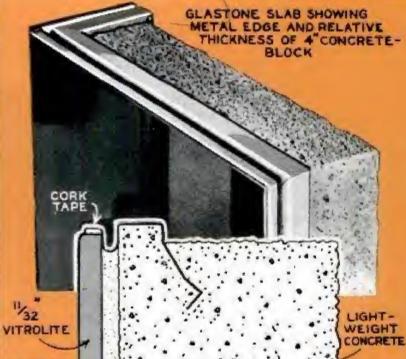




Plate-glass blank being deposited on grinding line. Plaster of paris is being spread to "set" the glass so it cannot move around under the grinding units.

A stimulus to a more widespread use of glass on the exterior of buildings and store fronts is the new plan of bonding and mechanically anchoring colored structural Vitrolite to a lightweight concrete block so it becomes a masonry unit and an integral part of the building.

You can now live in a glass house and if your pocketbook is fat, furnish it with everything from glass book ends to bedroom suites. A glass bed can be bought for 895 dollars, a chiffonier, a hundred dollars cheaper, and a dressing table and bench for 850 dollars, which gives you an idea. What about their strength? No worry there—it's all a matter of using glass of the proper thickness. Half-inch glass is sufficient for a chair back, while

portions of a dining-room table must be an inch and a quarter in thickness.

No construction material has ever scored such a pronounced success as has the glass block within the last year or so. Chief reason is the fact that it combines the light-transmitting qualities of glass with the insulating values of a solid masonry wall. With a sealed-in dead air space, seventy-five per cent vacuumized, a glass block is among the best insulators against temperature change. During the day, rooms are brightened with sunlight while at night, lights from within the home or factory create eye-arresting effects.

An aim of contemporary living is to bring the out- (Continued on page 128A)

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POPULAR MECHANICS Calif

'Bullet' Pursuit Plane Flies at 400-Mile Speed

Tested under the greatest secrecy, the new Vultee Vanguard plane, streamlined like a bullet, is said to be capable of traveling at speeds better than 400 miles an hour. The all-metal interceptor-pursuit ship is powered by an air-cooled radial engine of radically new design. Its chief claim to distinction, however, is its new construction which permits of rapid mass production.

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All-metal interceptor-pursuit plane, tested over Los Angeles recently, can be manufactured under mass-production methods if nation goes to war

Hydraulic "Tooth Puller" Wrests Pole from Concrete

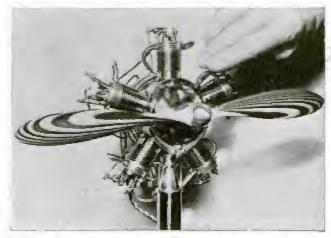


Jerking steel power-line poles loose from six feet of concrete is as easy as pulling teeth for a tractor-driven hydraulic jack that can develop pressure of 160 tons to the square inch. A collar is fitted to the pole and a single pump applies uniform pressure to four jacks, which tear the pole from its base in a few minutes.

To wrest steel power pole from its setting in six feet of concrete, four jacks are fitted to collar around pole and hydraulic pump applies tons of pressure

Tiny Airplane Engine's Lucite Crankcase Reveals Its Moving Parts

Concealed moving parts of a tiny five-cylinder engine are revealed by the transparent crankcase made of Lucite, a plastic. Thus may the onlooker view oil pumping, crankshaft movement and the ignition system breaking and distributing the spark. The engine has a fourteen-inch propeller that drives a miniature airplane. The cylinder bore is five-eighths of an inch and the stroke three-fourths of an inch. Push rods are ordinary sewing needles threaded and capped with a ball to fit into the rocker arms. Six flashlight batteries, stepped up to 30,000 volts by a cold, provide Ignition.



Through transparent crankcase of tiny plane engine you can see crankshaft movement and how oil pumps

Therelander 20

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Fish Ride Elevator and Taxi in Trip up River





There's taxi service available for the thousands of Columbia river salmon and steelhead trout that have found they way home to former upstream spawning grounds blocked by the Grand Coulee dam. A "census" of the fishing industry in the Coulee area indicated the seasonal runs are worth \$250,000 to \$300,000 to the fishermen, traders, and others dependent on these salmon and trout, and blockade of

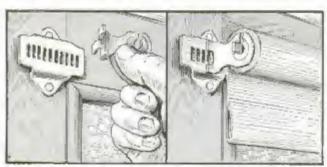
the spawning grounds would mean ruin to many. So the Bureau of Fisheries and U.S. Reclamation Service instituted the taxi service. As the migrating fish climb the "ladders" of Rock Island dam near Wenatchee, Wash., the smaller blueback salmon are separated from the steelheads and chinook salmon by different-sized pickets. The fish are counted as they enter an elevator bucket, and as soon as the required



"Taxis" carry fish around dam and dump them (top, left) at upstream spawning grounds. Pickets (circle) sort fish by sizes

load is reached the bucket is hoisted to a truck platform, where the fish and 500 gallons of water are discharged into a truck containing an equal volume of water. Ice-cooling systems keep the water temperature close to that of the streams. Eight of these specially designed trucks transported 50,000 fish to spawning grounds in tributaries of the Columbia river in the first season's transplantation,

Adjustable Bracket for Roller Shade Allows Leeway of Two Inches



When installing a two-piece window-shade bracket you do not need to observe exact measurements, for it can be widened or narrowed within a range of about two inches after it is in place. When the base has been fastened to the approximate position, the shade-holding fixture may be set in any one of several vertical slots to correspond with the length of the roller.

The master Key Can 2962 Harford

DESTROYER DESTROYER

Wersus, SUBMARINE

DAYS of easy hunting are over for the submarine. Today the oncedreaded underwater craft must do battle, with the odds against them.

The convoy system, adopted late in the World War, has deprived submarines of easy stalking of merchant ships, forcing them to attack in the presence of their deadliest enemy—the destroyer. Back in 1917, Kapitan-Leutenant Gustav Amberger had been ordered: "Remain out until all torpedoes are expended." And the German admiralty demanded a ship



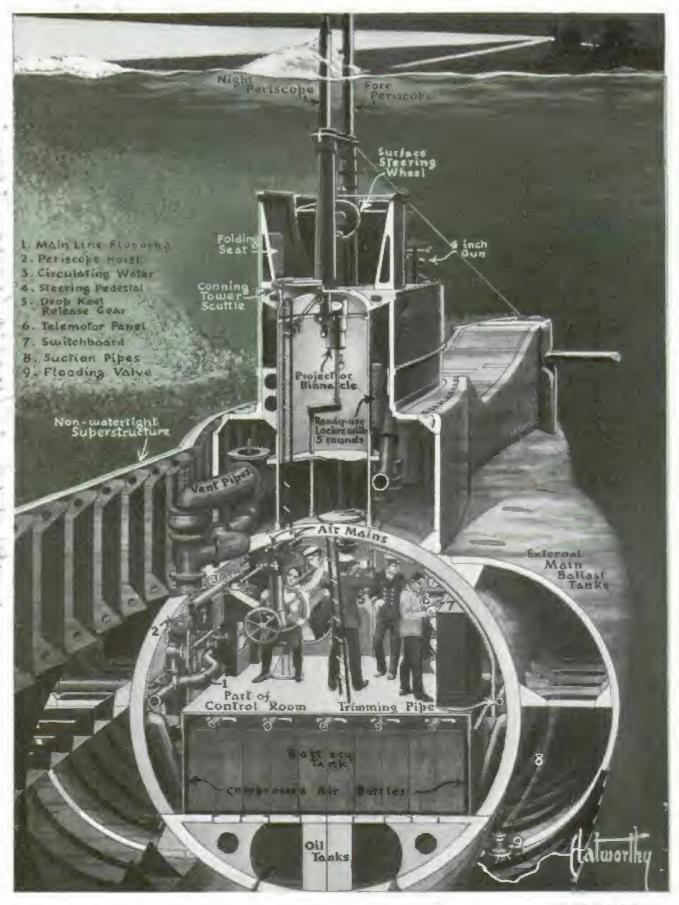
U.S.S. "Babbitt," top, is one of the fastest and most heavily armed modern destroyers.

Below, German submarine reaches base at Kiel, its path cleared of mines by sweepers

for each torpedo. So Amberger, facing the perils of attack under the convoy system, kept the "U-58" outside Queenstown harbor two days, waiting for victims.

At last came two destroyers, followed by eight ships in single file. Through the periscope, Amberger watched them. Submerged to fifty feet, with only an occasional peek through the upthrust eye, he maneuvered the "U-58" to intercept.

They came at him in four rows of two each, the destroyers curving among them.



@ S. W. Clatworthy

Cross-section drawing of British submarine shows the deadly craft submerged, its two periscopes just breaking the surface and leaving their telltale wake. Below is the projector binnacle and still further below the control room with battery tanks beneath. Buiges on sides are main external ballast tanks. Atop the conning tower is a wheel for steering while navigating on surface, and just forward is the four-inch gun used in surface fighting. The gun is used in preference to torpedoes whenever possible

POPULAR MECHANICS

Half an hour of tense waiting, of listening at the hydrophone to the increasing beat of propellers, while the "U-58" cruised submerged. Then a sharp order:

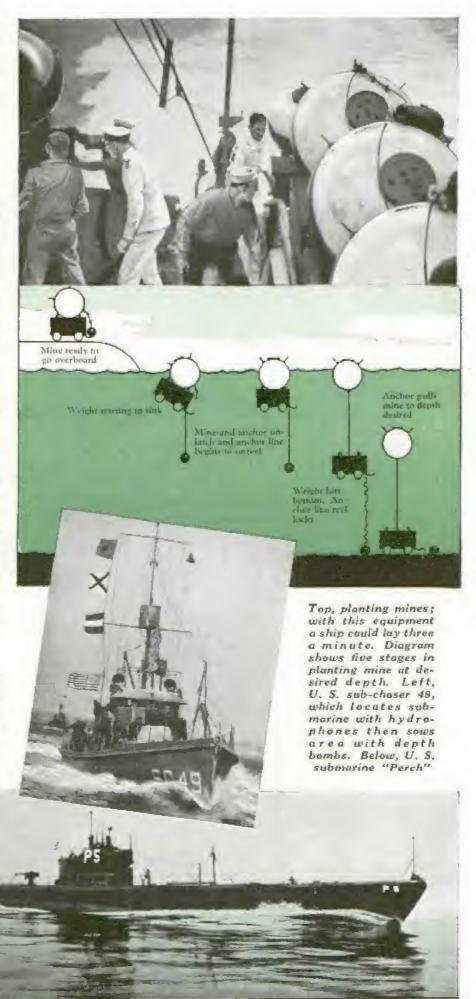
"Up periscope!"

A quick look and Amberger barked orders to the torpedomen, for there was the "Welshman," a splendid freighter, plowing into position 300 yards off his bow. A torpedo could not miss. Amberger walked the periscope around to select the next victim, before revealing his presence by attacking the first ship. But even the first torpedo was never fired. That swing of the periscope had revealed a destroyer curving down upon him.

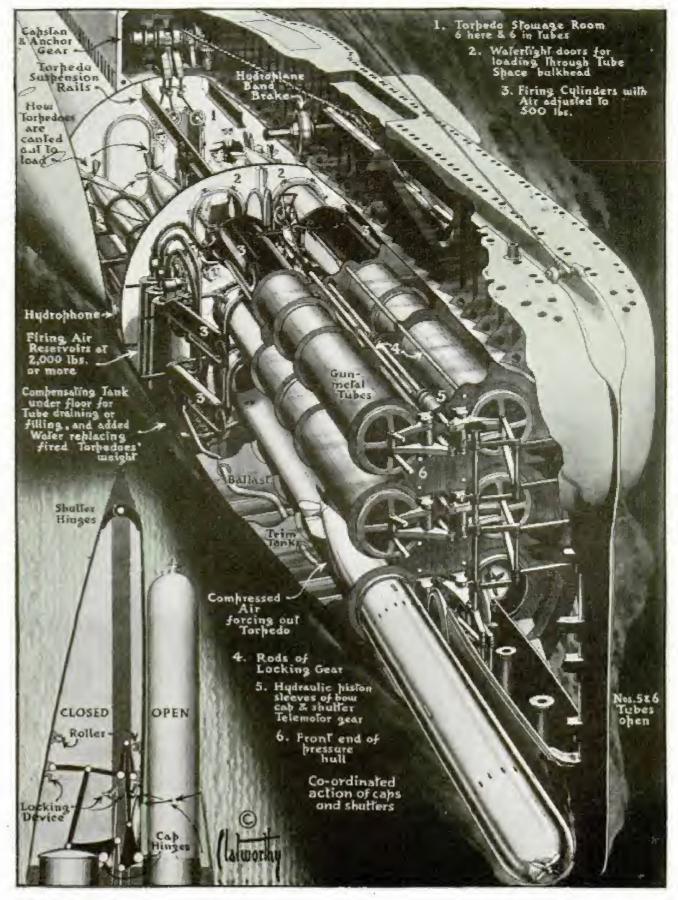
Aboard the "Fanning," one of two American destroyers convoying the merchant ships, Coxswain David D. Loomis scanned the water from his lookout post. Suddenly his sharp eyes caught something moving—a feathered, V-shaped wake.

"Periscope!"

Lieutenant Walter S. Henry sprang to the engine telegraph, barked "Rudder hard right!" at the helmsman, and the "Fanning" leaped into a



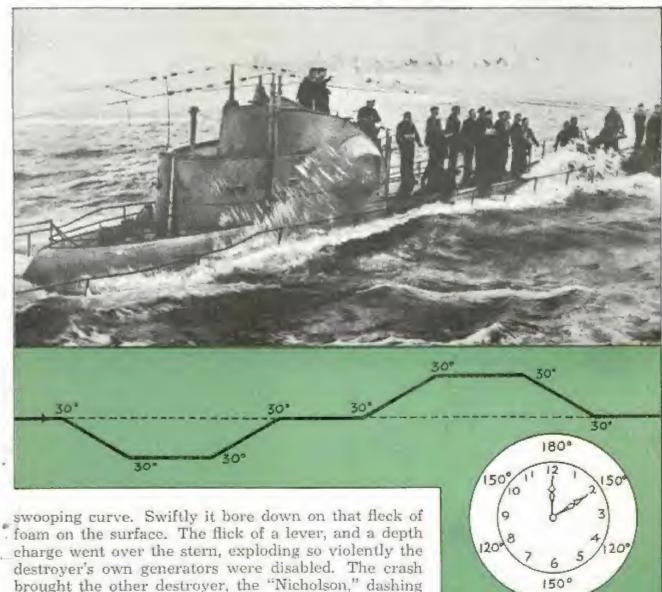
9 1250 PO



6 S. W. Clatworthy

This drawing reveals the essential mechanism for discharging a torpedo from a submarine. The deadly weapon, which travels forty to sixty miles an hour after being launched, is not fired from the ship by explosive but by compressed air which forces it from tube. The actual moment of firing is controlled from periscope amidships where tubes are aimed by maneuvering the whole boat. The inset at left shows the coordinated action of the bow caps and shutters as seen from above. This ship carries twelve torpedoes

3. D 10 1. 1



through the now furiously zigzagging convoy. The two destroyers swept in widening circles, while violent fountains spouted in their wakes. Fifteen minutes of blasting the depths gave no evidence of a hit.

Down under, the "U-58" lurched wildly at the first erash. Kapitan-Leutenant Amberger stared anxiously at quivering needles on the instrument board. He ordered all stations to report. No leaks. Controls still worked, Motors, badly jarred, but still turning, could probably be fixed in a short time. Between the jar of explosions, Amberger ordered a quick dive to greater

(Continued to page 159A)



Top, submarine "U-58," engines disabled by depth bombs, breaks surface and surrenders to U.S.S. "Fanning" in 1917. Diagram shows course of convoy ship; assuming initial course is 150 degrees, ship zigzags thirty degrees every ten minutes. Bot-tom, aboard an American mine sweeper

352 Wed al Placentia POPULAR MECHANICS

Shredder Makes Fertilizer





Top, shredder converts cull oranges into fertilizer and, bottom, loads it on waiting truck via chute

Surplus oranges are being turned into an asset through the invention of a machine that shreds them for use as fertilizer, and offers growers and packers a solution to their old problem of disposing of the unmarketable waste. The orange culls are fed into the machine and sixty-four stainless steel disks do the shredding. This shredded product next goes through a hopper and from there it is loaded into dump trucks which transport it to the groves and spread it along the tree rows. It is claimed that shredding aids in releasing the fertilizing value of the fruit and facilitates disking it into the soil. The machine is driven by a five-horsepower motor.

Welding of "Pocket" Battleship Saved 500 Tons for Arms

Forced by treaty to keep the tonnage of a battleship down to 10,000, Germany sprang two surprises in building its "pocket" dreadnaughts, one of which is shown on the opposite page. These two unique features were electric-welded plates, which saved 500 tons under the conventional riveting method, and the introduction of Diesel engines in heavy warships. By saving weight through the abolishment of rivets, it was possible to install heavier. armament and extremely powerful engines -which stretch over one-fifth of the ship's total length-developing extraordinary speed. The eight sets of two-stroke Diesel engines are rated at 6,750 horsepower each and each group of four engines drives on propeller shaft. The principal armament consists of forward and aft turrets carry ing three eleven-inch guns each. In addi tion there are several lighter guns, antiaircraft batteries and torpedo tubes. seaplane is carried just aft of the funnel, launched by catapult.

Self-Grinding Steam Valve Disk

Makes Accurate Contact Spinning at high

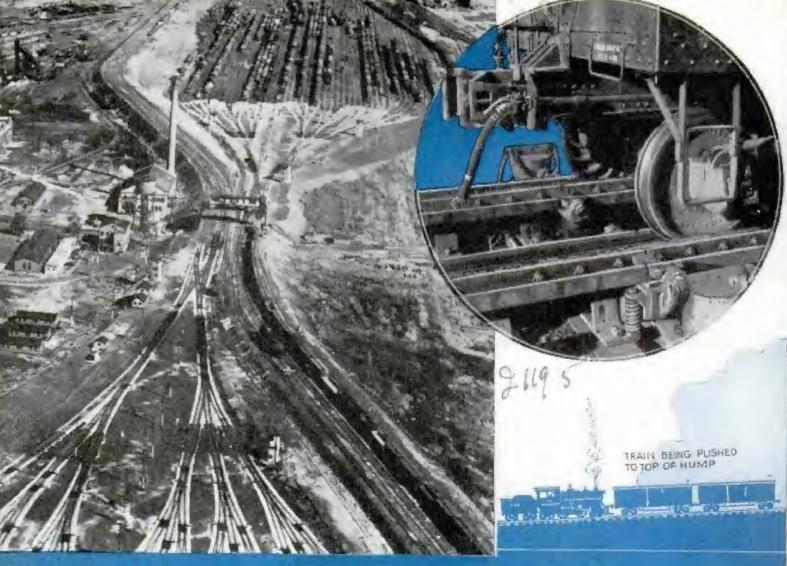
Spinning at high speed just before it closes against the seat, the disk of a self-grinding steam valve throws off scale and foreign particles and insures a metal-to-metal contact of polished surfaces. A reversing chamber directs the steam flow to turbine



vanes, causing the disk to rotate. The turbine vanes are shielded from the steam flow when the valve is open.

Portland, Olegon

MAIN FIRE CONTROL TOP AND THE LATTER IS SAID TO HAVE SAVED TO TONS IN WEIGHT BY ABOLISHING RIVETS DIRECTOR TOWER RIVETS DIESEL ENGINES 5.9-INCH GUNS HYDRAULIC CLUTCHES WELDED | DIESEL ENGINES ANTI-TORPEDO BILGE AIRCRAFT AND CATAPULT AMMUNITION 3-POUNDER A-A-GUNS engines, carries heavy armament although its tonnage is only 10,000. Use of electrically welded joints, instead of heavy riveted joints, resulted in a vast saving in weight—as much as 500 tons. There are few ships with sufficient speed and armament to catch and defeat German "pocket" battleship, which is driven by powerful Dieses AFTER 4.1-INCH A-A GUNS QUADRUPLE TORPEDO TUBES this type of craft



The FAST FREIGHT



Center of "hour glass," top, left, is hump of freight classification yard at Clearing, Ill., near Chicago airport. At right, freight car stopped by retarder. Bottom, the old way; before remote-controlled retarders arrived, a brakeman rode each car down from hump and applied brakes by hand, a risky business

By Roderick M. Grant

WHEN a trainload of California grapes and eggs and Seattle salmon rolled over the hump in Chicago the other day and in just ten minutes was snaking out of the yard behind the engine of an eastbound freight, it was something for old railroaders to chin about in the smoker of the 5:15.

They could remember the log jams back in '14, when freight terminals were blind alleys and carloads of vegetables rotted on the track, forgotten by all but the neighbors and the consignees, and trainloads of reapers and hoppers full of

Bell Carlinary of Checago

seed were lost on sidings until the harvest was in.

In those days the rails in Chicago were glutted with neglected freight. A carload of cement might lie five or six weeks waiting to get across town to a southwestern railway. Perishables perished, claims against the railroads because of delays were staggering. If your



CUT RUNNING AWAY

GOING THROUGH RETARDERS

TO SIDING

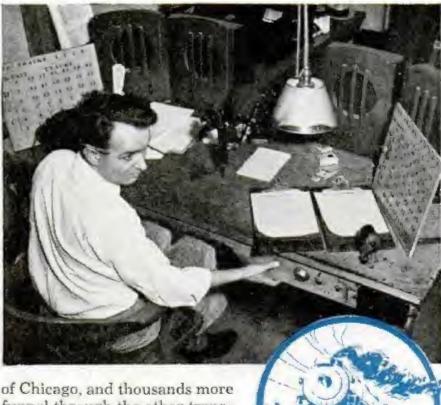
RIDES the HUMP

furniture factory in Kankakee was threatened with a shutdown for want of lumber ordered from Minnesota, you'd have to send your man to hunt up the shipment; once located, he could probably get it started your way by quietly tipping the right man. It was no secret then that a railroader who could get your butter and eggs out of the jam might make a little money on the side.

Today 3,500 to 4,500 cars a day roll over the hump in the classification yard at Clearing, Ill., southwest



Towerman at top operates switches sending boxcar to proper track, and, judging speed and weight of car, turns controls applying retarders. Bottom, view at hump as powerful engine pushes last car down grade. Foreman in shanty supervises uncoupling cars according to "train consist" list



of Chicago, and thousands more funnel through the other transfer yards around Chicago, terminus of twenty-five trunk lines. The log jam is broken. Come prosperity, come war, freight will flow on smoothly across the country.

One of the world's busiest men is the humpmaster at Clearing, newest of the automatic freight-sorting yards. From his

tower straddling the hump, surrounded by telephones and Teletypes and loud speakers, surveying 180 miles of track spread fanlike to east and west, he directs the interchange of freight between north, east, south and west. The Belt Railway of Chicago opened its pioneer humpyard in 1915; today it has been rebuilt, completely mechanized. Missing from the picture are the brakemen who swung on hand brakes as the cars rattled down hill, threading switches into the outbound yard. In place of the car riders are towermen who operate switches by remote control, and twist a controller that clamps retarders against the wheels to hold the car to a safe speed or halt it until a switch is clear.

Let's pick up a fast freight from the Burlington laden with prunes and lumber, pears, rye, eggs, clay, feldspar and sugar,



Hampmaster, top, watches operations from post directly above hump and has telephone and loud-speaker connections to every tower and shanty office. Below, a heavily loaded boxcar slows down on a retarder

as it pulls into the west receiving yard at 4:55 a.m. It has some quick connections to make for eastern and southern points.

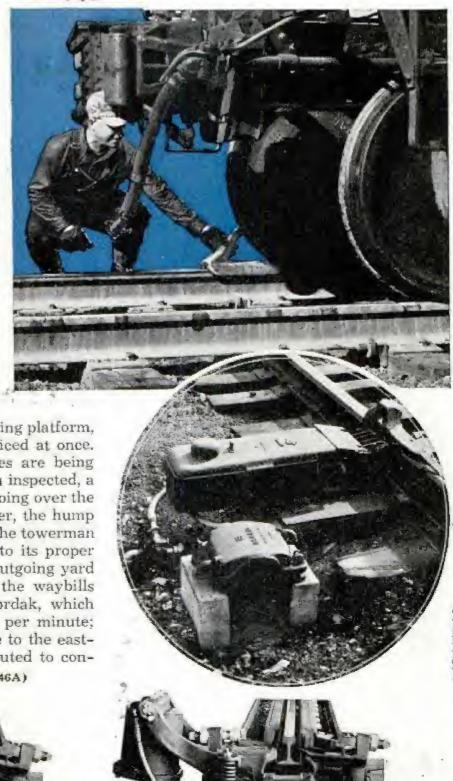
Waybills are dropped at the receiving shed and immediately shot by pneumatic tube to the Teletype room at the hump. Meanwhile a checker notes the number of each car as it passes, calls it off, and a list of the cars is typed showing their position in the train, car number, contents, outgoing railroad and its track number in the eastbound classification yard. The fourth car in the train, a load of pears for an Erie train leaving at 7:05, must be re-iced, so

the train is sent along the icing platform, where 90 cars can be serviced at once.

While cars of perishables are being re-iced and the whole train inspected, a multiple list of the cars is going over the Teletype to the humpmaster, the hump conductor's shanty below, the towerman who must route each car to its proper track, and to the eastern outgoing yard office. At the same time the waybills are run through the Recordak, which photographs them at fifty per minute; the waybills go on by tube to the east-yard office and are distributed to con-

(Continued to page 146A)





At top, yardman places a hand skate on rail to hold a string of freight cars; in center is an automatic skate thrown on rail by remote control. Bottom, sectional view of retorder in open position with brake beams released (left) and with air applied and retorder closed (right)

Electric "Hot Dog" Cooker Has Automatic Shut-Off



Electric current creates heat inside "hot dogs" to cook them, and automatic switch prevents shock

Electricity cooks frankfurters by an "electrocution" method using a "cold" grill which has no heating element. Both ends of the "hot dog" are pushed down overneedle-sharp contact points and the switch is turned on by closing the cover. Cooking is done with internal heat created by the electric current passing through the sausage, and requires but a minute to complete. The safety switch cuts off the current as soon as the cover is raised.

Circular Electric Outlet in Wall Takes Plug at Any Angle



Less annoyance in plugging in an electric appliance is claimed for a wall outlet with circular openings in stead of the usual parallel ones. The ordinary two-prong plug is

inserted easily anywhere in the circle, one of the points being thrust into the outer ring and the other making contact through the inside ring.

Spring Clip Holds Film on Reel to Keep It from Uncoiling

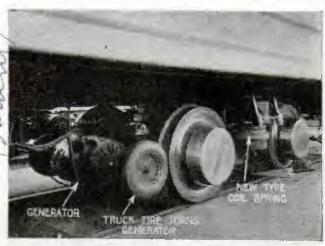
Movie films cannot jump out and uncoil from their reels if a clip now on the market is used to hold them. It fits between the reel flanges, and



spring fingers fasten the film securely. It is available for either eight or sixteen-millimeter sizes. A matte outer surface provides space for marking the title or other film identification.

Light Truck with Rotary Brake Gives Smoother Ride on Rails

In three years the Milwaukee railroad has reduced the weight of its passenger-car trucks from 50,000 pounds to 25,000 pounds per car, the newest trucks proving not only a notable saving in cost but producing a smoother ride. The lightweight truck just introduced has inboard bearings



Notice absence of conventional brake shoe on this new type railway-car truck, which has rotor brakes

of automobile type instead of the conventional outboard bearings, and coil springs with snubbers replace the former elliptical springs. The brake shoes which applied friction to the wheel tread are gone, and in their place are rotor brakes which stop the car more smoothly and with less noise; they

adam Fisher Co

mad.

have 576 square inches of braking area in contrast with the ninety-two square inches of the conventional brake shoe. Another innovation is the use of a small automobile truck tire, turning against the wheel tread, to drive the generator. The saving in costs by a weight re-B. duction of 25,000 pounds is evident when it is con-Pr sidered that it costs the railroad nine-sixteenths cent per year to haul an ounce of dead weight.

Two-Quart Carton for Milk Brings Lower Price

Cost of milk to consumers has been reduced one and one-half cents per quart as a result of the introduction of a two-quart paper container by a distributor in New York City. Because of its rectangular shape, the package takes up less space in the refrigerator than do two single quarts.

Barges Hold Span of Bridge While Cables Are Replaced



Lowering one of five sections of center span to barge in river to relieve weakened cables of their weight so they may be replaced with new ones



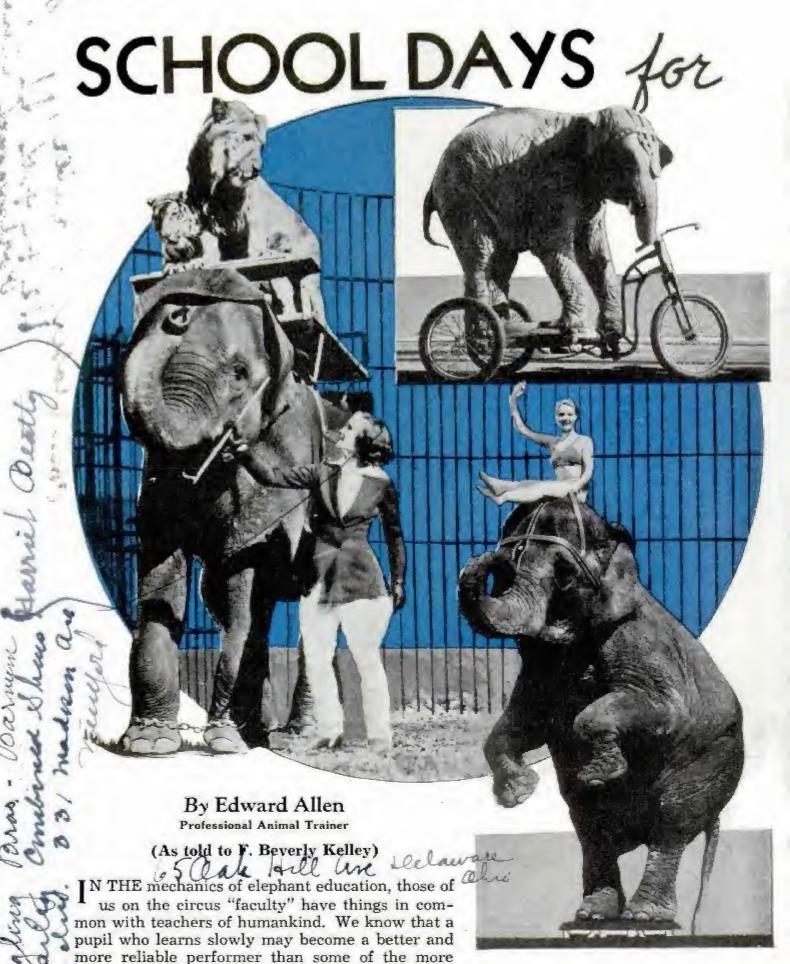
Delivering two quarts of milk in one carton instead of two glass bettles has lowered price to consumer

Failure of two huge cables supporting a bridge at Portsmouth, Ohio,—believed to have been caused by the flood of 1937— made it necessary to remove the old cables and install new ones. Before lowering them, however, engineers were faced with the problem of relieving the cables of their enormous burden—a 700-foot center span. The solution was to remove 350 feet of the center span in five intact sections, and to cantilever the two 175-foot ends. The sections, each weighing sixty-two tons, were lowered to barges, on which they would remain until the new cables were in place.

(Send return postage to our Bureau of Information to learn the name of the maker of any device described in this magazine.

524W574

\$1227



Lion and tiger riding elephant (left); going through cycle-riding routine (right), and a familiar sight at the circus (bottom)

19. 1

innately talented who learn very quickly. And, like

the misfit who was molded for manual accomplish-

ments far removed from the ivy-clad walls of high-

ELEPHANTS

er education, there are elephants that are absolute failures as actors but that make

good workers in harness.

The first thing to teach them is to understand plain English and to obey commands when they are given. Once Bill Emery went to New York to unload a pair of young elephants purchased from a South American circus and guaranteed to be perfectly trained. Trouble began as soon as he tried to get his passengers off the ship. Simple commands that any trained elephant should have obeyed had no effect on the "foreigners" unless it was to make them more stubborn.

The difficulties encountered at the dock were minor compared to the task that loomed



@ Ringling Bros. and Barnum & Bailey

Top, the elephant as a clown draws laughs from circus crowds. Below, trained elephant carries woman performer. This act must be executed carefully to avoid injury

once the elephants had reached the circus. The circus manager cabled the former owners that the "trained" bulls didn't know a single trick. Next day a cablegram arrived, explaining that these animals had been trained in Latin America and, of course, they didn't understand English.

In teaching elephants you use only simple words and use them over and over again until the animals respond.

The wise trainer feels out an elephant's mind and tries to discover what the animal wants to do. Some tricks will be attempted by the beast with more willingness than others. No matter how long it takes them to get

POPULAR MECHANICS They are: standing on the hindlegs, lying down on the left side, sitting up on the ground and standing on the head. The leg stand is the hardest to teach because it requires development of those muscles and entails a balancing of great weight. This calls for a rigging which consists of ropes running from each front foreleg, through a pulley and into the hands of a capable assistant. The animal usually has a drumlike seat placed behind it and this helps with the balancthe "feel" of a trick, they must not be hurt or caused to lose confidence in what they're trying to do. There are four principal tricks that an elephant has to learn before a circus act can be routined. Hazardous "Head Carry" ing, enabling it actually to sit (top); elephant performing down as the hoisting takes place. the difficult trick of walking a plank (center), and Similar rigging is then used on its Jean and Eddie Allen with elephants that have been trunk so that the elephant may be taught a military drill taught to lift its trunk in salute as (bottom) it stands up on its hind legs. As the lifting takes place, the trainer lan and

POPULAR MECHANICS

shouts the command so that the animal soon associates the sound of the word with the trick itself.

To the casual spectator the head stand seems most difficult; really it is a comparatively simple trick to teach because the trunk acts as a balancing leg. After an elephant has mastered these four tricks, you can start building the act. The waltz, mounting of other elephants, working on tubs, dancing and "London Bridge" call only for patience and understanding.

Teaching an elephant to shimmy calls for plenty of patience, I begin by having a large grain sack filled with sand placed in the middle of the back with the weight divided on each side. Then we tell the elephant to "shake it up!" Most elephants like to throw things onto their backs and shake them off, so the first thing you know the elephant is doing its best to dislodge the sack. This is done repeatedly and the command to "shake it up" accompanies each trial, so that in about two weeks the sack can be discarded, for the elephant gets the idea and starts to shimmy when the word is given.

Two years ago, Clyde Beatty and I decided to try something really spectacular, to train an elephant to carry both a lion and a tiger on its back. Harriet Beatty, Clyde's wife, was to present the act once it was broken and ready.

Of two dozen elephants in the circus, there was only one that I felt pretty certain would do. This was a young female of about fifteen summers, almost perfectly developed and possessed of a rather quiet disposition. I first taught it to carry a howdah, which in this case turned out to be a platform wide enough for both cats, and this required about two weeks of rehearsal.

Then it was taken into the steelbarred training arena so it might become familiar with the smell of the cats. For several days we sim-

(Continued to page 139A)

Portable Plug-In Traffic Light Guards Street during School





Policeman plugs pedestal into socket at center of crossing, then sets traffic lamp on top to operate during school hours

For guard duty at school crossings where protection from passing automobiles is needed only during the hours before and after classes, there is a portable traffic light that plugs into the pavement. An officer fits the pedestal into a contact socket in the street, then places the automatic stop-and-go lamp on top of the post.

Overexposed Films Are Corrected in Process of Development



Both underexposure and overexposure in the same film roll are corrected when a new developer is used in conjunction with a combined tank and squeegee. The film is immersed in the tank for about one minute and then placed in close contact with a smooth in

ert surface by means of the squeegee. As only enough of the solution has been absorbed to permit development to a predetermined density, it continues to build details in the shadows after developer in the highly exposed areas is exhausted.

¶Medical authorities say the human heart at rest pumps blood at the rate of 3,000 foot-pounds of work per hour; at hard work, the figure might reach 15,000 foot-pounds.
↑

merican medical

Giant High Chair Near Road Attracts Eyes of Customers



Gigantic proportions of this 100-pound high chair draw attention of prospective customers to firm's place of business alongside highway

Driving along a highway on the west of coast, tourists behold an enormous high schair displayed prominently at the roadside. It was made by a manufacturer of playground equipment to advertise his place of business. Built to scale, the chair weighs 100 pounds.

Farm Crops to Take Infrared and Ultraviolet Treatments

Ultraviolet and infrared radiation will find many a practical application on the farm, when electric current is available at an economical level and suitable equipment is developed. The electrified farm of the future, for example, may use infrared

heating elements to dry hay quickly, to heat poultry houses and keep new-born animals warm. Incandescent lamps with globes that emit ultraviolet rays may be used in greenhouses to promote well-proportioned plants growths by closely approximating natural sunlight under better-thannatural control. Germicidal ultraviolet lamps could be installed in stables and dairies to kill air-borne germs, to control epidemics amonglivestock and check fungi growth in grain and have

Skidless Holder for Roast Makes It Easy to Carve

Inexperienced hands carve roasts with skill when the meat is an chored to a skidproof holder. The base of the holder is a metal disk with suction-cup feet to grip the platter, and there are five upright pins on which the roast or fowl is impaled. Thus more uniform slices can be cut.



Sharp-pointed pins of roast holder keep meat steady on platter to make carving an easy task for anyone

Retractable Catwalk Speeds Engine Servicing

When it is time for the mechanic to service or repair the engine of a Martin transport plane, a retractable catwalk is swung out from the wing next to the nacelle. From there vital parts are within easy reach, and after the job is finished the platform is swung back where it fits flush in the leading edge of the wing.

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Mechanic stands on retractable catwalk while servicing engine; when job is finished, catwalk is folded into wing

"Ears" for Mechanical Brains Help British Air Defense

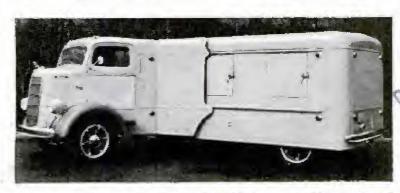


One factory in England is turning out "ears" by the dozen to be used in defense against air raids./ Called paraboloids because of their shape, the ears are fitted to sound locators which can detect the approach of airplanes.

> Rows of mechanical ears on factory floor being prepared for assignment in England to a twentyfour hour watch for approach of enemy planes

Sliding "Wings" Streamline the Sides of Tractor-and-Trailer Truck

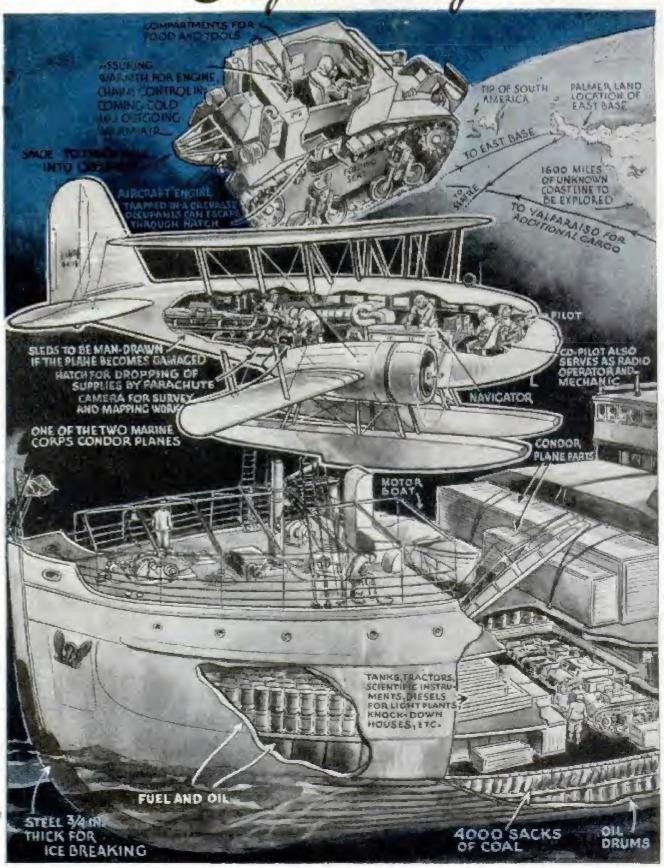
"Wings" sprout at the sides of mammoth tractor-trailer trucks to conceal the space between and give them the appearance of a single unit. As installed on one icecream truck of 750 gallons capacity, the vertical metal panels slide at one end so they will not interfere with turning. The streamline effect results in reduction of wind. resistance on long hauls and improves the truck's appearance.



Open space between tractor and trailer is concealed by "wings" at the sides, which slide along body when vehicle makes a turn

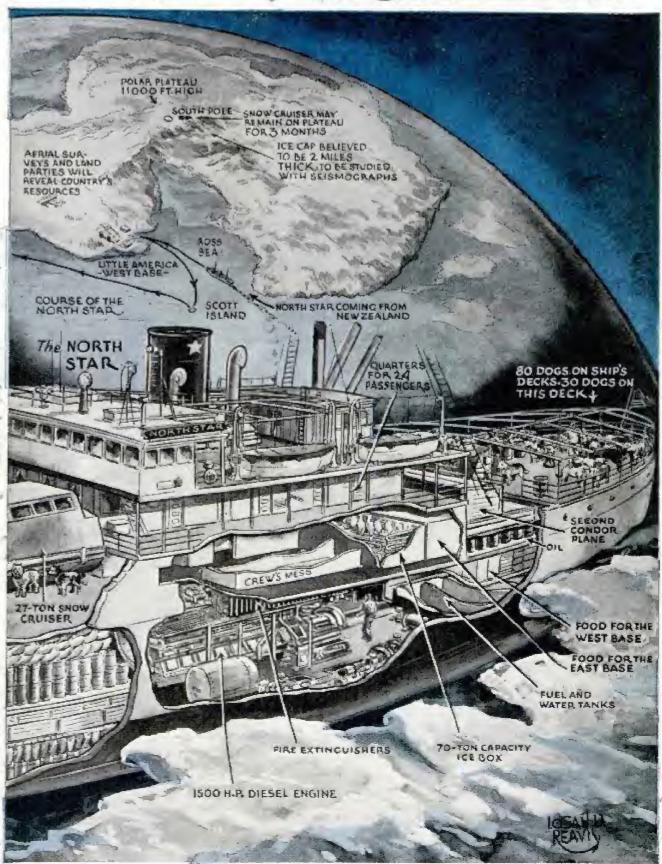
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Exploring the



Exploration of vast areas in the Antarctic by the Byrd expedition is in progress, with the objective of claiming a large territory for the United States. The "North Star," pictured on this and the page opposite, was selected after investigation of many ships. It is 226 feet long, has a beam of forty-one feet and its hull is rugged enough to withstand severe ice pressure

AST FRONTIER"



Aboard the "North Star" is complete equipment for exploring the Antarctic. Army-type tanks, tractors and several airplanes will enable the expedition to room far from its bases. The giant Snow Cruiser also is expected to aid. Note the route of the expedition along the coast. The expedition is expected to spend several months in the vicinity of the South Pole

Gas Plant on Bus Trailer Makes Fuel to Run Engine



Buses and trucks in London carry their own generating plants for making fuel gas from low-grade coal to conserve Britain's gasoline supply for war needs. A "gas producer" recently introduced is mounted on a special trailer, and as fuel is generated it is piped to the engine.

Sky Camera Made of Solid Glass Peers Farther into Space

Astronomers have pushed back the boundaries of space with a sky camera made of a block of glass, which they use with a powerful telescope. Developed at Mount—Wilson—observatory, the camera permits the 100-inch telescope to "peer" farther into space than ever before, revealing facts about stars and nebulae which are beyond its ordinary range. This camera is constructed from a block of highly transparent glass and measures about two by three inclies. The front of the block is flat and the back is concave and covered with aluminum. The photographic plate

rests on a thin glass plate cemented to the front, the contact being made through a film of oil. It is its greater light-gathering ability and the sharper definitions produced over a larger field that enable this piece of glass to expand the known universe.

Rustless Hot-Water Tank Is Porcelain Enameled

Coated inside and out with porcelain enamel, hot-water tanks for the home are made in attractive colors that match kitchen stoves and refrigerators while the inside lining withstands the corrosive action of hot water under pressure, and will not deposit rust in the water. Welded on a 30,000pound machine, the seams are so smooth that they are virtually impossible to detect.

Flower Box for Window Suspended from Sash

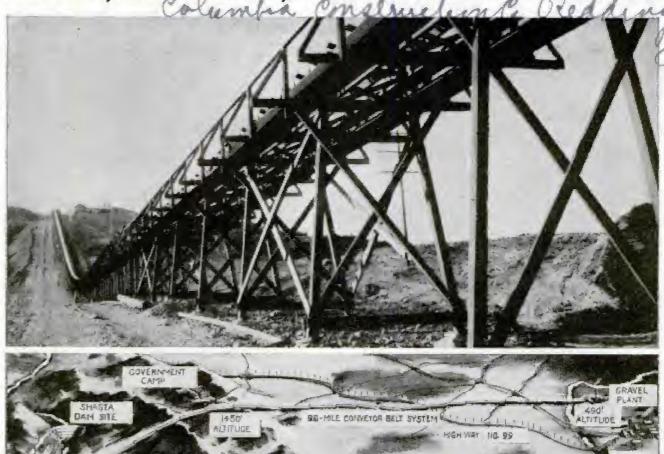
Indoor hanging gardens can be planted all year around in a wind dow box that is designed for easy installation. Two hangers hold the box and are fastened to the sash by brads. The box may be removed from the hangers, if preferred, and set on the window ledge.



Flower garden in window box is suspended from sash by two sixteen-inch hangers that are easy to install

71044.11, made

Twenty-Mile Belt System Hauls Grayel to Dam



SHASTA
DAN SITE

1450'
ALTITUDE

BUNKENS
650'
ALTITUDE

SACRAMENTO

GRAVEL
PLANT

490'
ALTITUDE

RECOING

RECOING

Top, a cross-country belt conveyor like that which is to carry materials from Redding, Calif., to Shasta dam. The map shows how the twenty-six epdless belts climb a range of hills, then drop to site of dam

More than twenty miles of rubber-covered cotton best will be used in the conveyor system to carry sand and gravel nine and six-tenths miles from Redding, Calif., to the site of the new Shasta dam. Twice as long as any previous conveyorbelt system, it will haul as much as 1,100 tons of construction materials per hour, moving at 550 feet per minute. It is expected that four years of operation will be required to complete the 10,000,000-ton dam project. The belt itself, to be installed in twenty-six endless units, will weigh about 1,500,000 pounds, including a million pounds of rubber and 1,000 bales of cotton. The conveyor system will cross the Sacramento river twice, pass over several highways and creeks and a railroad, and will climb nearly 1,000 feet over a ridge before

dropping to the site of the dam. Each unit is to be driven by a 200-horsepower motor, except for three units which travel downhill and generate power.

Electric Scissors Plug in Outlet, and Cut at Touch of Button

Now the oldfashioned scissors have gone electric. Press the button with your thumb and the "plug-in" shears zip quickly and smoothly

through cloth or paper without effort. The chrome-plated steel blades are precision-ground and the case is of ivory plastic.

BUG HUNTERS Wage



Top, left, distributing parasites on leaves of tree. Right, testing truit for parasitic activity. Bottom, cages of insects and parasites on way to United States

ful bugs to help man save his civilization. Hunger, hardship, disease, adventure, romance—they're all in the day's work for these men

to whom bugs are bread and butter.

WAR on INSECTS



Top, left, testing insects' reaction to light. Right, sunroom in which insects and parasites are propagated. Circle, access to cage is through sleeve that prevents insects from escaping

Should you visit a bug store you would see an order counter, with busy clerks, and to the rear, heavy double-screen doors cutting off the office from the laboratory. Through the doors, you might hear a dialogue like this:

"Hey Mike, have you got that order of ten thousand beetles packaged yet?"

"Take your time, I'm busy!"

"Well, the customer is in a hurry."

"Then come back here and help me get this consignment of black widows ready for shipment."

Now, what's it all about? What is the use of bugs, that whole businesses can be built around the raising and sale of them?

One of the largest customer groups is educational; high schools and colleges. Their demand for bugs of all kinds for their laboratories is enormous. Research laboratories of all kinds make another group. It has been found that many of the experiments on the potency of serums, on the virulence of bacteria, and on the strength of vitamins can be made by in-



jecting several types of insects, particularly roaches. Once such animals as guinea pigs, rats, rabbits, etc., were used. This was far more expensive, and the results of the experiments usually took longer to determine.

But the most romantic and adventurous phase of the whole industry is military. The next time you speak of the United States military strength remember it consists of less than a million men who can be mobilized quickly, but that we have a mercenary force of over 10,000,000,000,000 in sects fighting a war against our enemies right now.

It is to find these mercenaries that men enter the jungles, fever-ridden islands, danger and adventure.

Every insect should have, according to entomological theory, an insect parasite, which keeps its numbers in check, otherwise it would overrun the world. But many species of insects have been brought far from their native homes by commerce, and in some cases, they have left their parasites behind. For that reason, they thrive in their new homes, and cause man heavy damage.

Methods used to trace, down the original homes of insect pests, so men may be sent to collect parasites, are like the thrilling incidents of a combination detective-adventure story.

First clue to be examined is world trade routes. Suppose a certain pest had attacked crops in western United States, and it was found to have no restraining parasite. That would be a fairly sure indication it was an undesirable alien. To find its home, research would be made to determine other places it appeared. Suppose a search had been made in Asia without finding it. It was

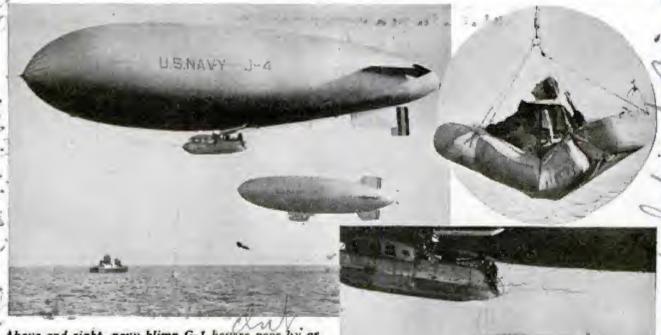
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Top, hothouse in which specimens are kept before developing wings. Center, forcing food into cage in a spray breaks hunger strike. Bottom, testing insects with plants to determine immunities and parasitic activities

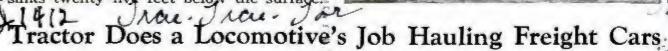
Leased by Leit. Centre.

Blimp'Rescues' Man at Sea on Raft'Stretcher'



Above and right, navy blimp G-1 hovers near by as J-4 raises man into gondola from sea; circle, going up

from the sea by a blimp was demonstrated in tests conducted by United States navy blimp J-4 ten miles off New Jersey's coast. It was proved that men can be lifted aboard a blimp either from the deck of a boat or from the water's surface. In performing the "rescue" an inflated rubber life raft, like those carried by seaplanes, served as a stretcher to haul the man safely into the blimp hovering about fifty feet above. To anchor the ship a drogue, a circular metal disk, is dropped by a cable until it sinks twenty-five feet below the surface.





Needing no rails, tractor hauls freight cars in yard operations and can move to next track to pick up another string without using switches

Tractors are being put to work on tasks traditionally assigned to steam, and more recently to Diesel locomotives. Small tractors capable of handling several freight cars are used in yard switching operations, either pulling or shunting the cars. Since it is independent of rails and switches, the tractor is not restricted by track limitations but can maneuver readily from one string of cars to another.

terralemal parriete

Germ-Free Crib for Baby Safeguards Health



Baby breathes only clean air in this germ-free crib sealed to prevent entry of air-borne contamination

Babies now can be protected against contagious diseases in a "baby cubicle," conditioned to keep out germs borne in the air or brought into the nursery by humans. It is one of the first practical applications of experiments with germ-free enclosures at the University of Notre Dame

Magnifier Held on Flashlight Helps View Close Work

Mounted on a spring clip that can be clamped easily on a flashlight having a diameter of one and three-fourths inches,



Magnifier that clips on flashlight can be mounted on stand, as at right, to leave both hands free

a magnifier helps reduce eyestrain in doing close work. The lens may be tilted to correspond with the light beam, and one hand, remains free while the other holds the light and magnifier. Among its many uses, it is handy for inspecting electrical connections, laboratory work and household appliances, or for reading fine print.

N w Tale & A life

Electric Screen for Killing Flies Has Protective Grille

Flies and other insects are electrocuted upon contact with an electrified screen that is easy to install in the door, window one transom. Made to order to fit the opening the screens are entirely automatic. The transformer requires a normal input of four watts. A lightweight metal guard is



Protective grille covers electric screen able to kill flies but not injurious to humans and animals

available for installations where the screen is within reach of persons or animals. The manufacturer says the screen's injurious power affects only insects.

■Send return postage to our Bureau of Information to learn the name of the maker of any device described in this magazine.

Miniature 'Street' on Auto Measures Lighting

Rapid diagnosis of faults in the lighting conditions of any street is accomplished by an automobile that carries a miniature street projecting over its hood, the latest weapon offered by the General Electric company to help eliminate the causes of traffic accidents after dark. The tiny street model, mounted forward like a stubby springboard, is given a reflecting surface similar to that of the street being tested, and upon it are placed a number of typical obstacles. Above the windshield is a glare collector that measures the total glare from all street lamps within the driver's view and the loss of vision it causes. On the front seat is a control box, on which are dials and selector switches that the operator manipulates. It automatically records on a card measurements of visibility, brightness and glare.





Top, note figure on miniature "street" directly above headlight lens; "eye" over windshield measures glare. Bottom, making street-light test

Tracer Bullets from Machine Gun Prove Its Accuracy

Tracer bullets, which leave a luminous trail from the muzzle to their mark, were used in a sub-machine gun when a G-man

demonstrated its accuracy before police at a west coast city. A photograph taken in a fraction of a second with flash-bulb light-

tracks of eight bullets streaking toward the target, all striking the figure in the chest and stomach.

The surface of a human lung is equivalent in area to the ground occupied by a house thirty-one feet square, and in a normal day's respiration you breathe air that would fill a room seven by seven by seven feet.



Photograph of tracer bullets shows accuracy of machine gan by revealing their paths from the weapon as well as points where they strike target

Civil War photos by Brady Above (on this and page apposite), artist's conception of first battle of Bull Run. Top, left, Civil War artillery depot. Below, field piece camouflaged with tree branches time maneuvers. Sixteen thousand national guardsmen and reservists are out here to smash the attack of a streamline division of regulars, but there is little to see.

PLAGS flying. Bugles blowing. Bewhiskered generals on white chargers waving swords, urging their men on in closepacked ranks against gray-clad warriors massed on the hill. Congressmen riding out from Washington in horse-drawn buggies to see the spectacle.

That was Bull Run of the Civil War. Battle, then, was a spectacle.

Comes the third battle of Bull Run, in 1939, and Americans are once more pitted against Americans, in our greatest peace-

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A khaki-clad figure advances cautiously down the edge of a country road, rifle at the ready. Behind him on the other side of the road comes another soldier. Then a third and fourth, all widely spaced. From a clump of bushes up the hillside a machine gun stutters, and the point of the advance guard disappears, firing tentatively from cover at the unseen gun.

The din increases as invisible artillery opens a shattering fire from somewhere a mile off the road. A pair of observation

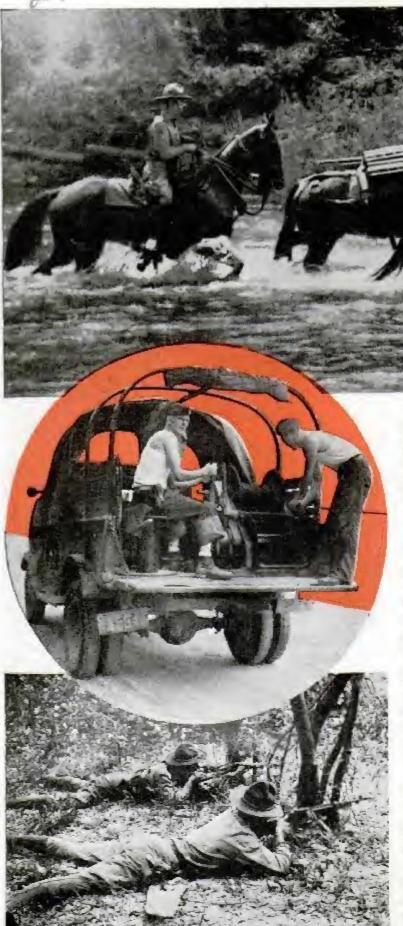


planes drones overhead. There is a rumble and clanking from bushes off to the flank, and half a dozen tanks lumber past toward the nearest machine gun, which breaks into insane chatter, then suddenly stills. And that is all, though this is the main attack.

As a spectacle, our modern battle is a complete washout. Flags cannot fly; they would draw fire. The general cannot lead a charge; a charge today is a sneaking and dashing from cover to cover by small groups of men, widely separated to offer poor targets.

So the general stays back in his tent, which would be a dugout in





Courtesy U. S. Army Signal Corps

Top, cavalry machine-gun squad, such as this, can maneuver quickly over rough terrain. Circle, laying field telephone lines at twenty-five miles per hour. Bottom, rifleman and automatic rifleman firing from behind cover

case of real war—not for his own safety, but because it is only back here that he can control his scattered troops. A brigade is now spread over several square miles of territory.

From the headquarters tent to regiment, then battalion, then company, the general is in touch by radio and phone. With truck or handcart or breast reel, signal troops lay wires as fast as the fighting lines advance. And when that isn't fast enough, or when a staff officer moves around off the lines of communication, a private goes along with a pack radio slung on his back, so the officer may report what little he can see of the battle.

And though there are only 20,000 men here, as compared with 67,000 in the Bull Run of 1862, the killing power of this modern force is vastly more effective.

When the Civil War opened, the entire federal army possessed only eight batteries of artillery, totaling but forty-eight pieces. Half of these were three-inch muzzle-loading rifles having a range of 2,800 yards. The other half were twelve-pound smooth-bore Napo-

leons, with a range of 1,520 yards. But beyond 600 yards the effect of the smooth-bores was very uncertain. The velocity was so low at long ranges that alert soldiers could and did dodge the shot, which came at them only twice as fast as would a hard-hit baseball. Working at top speed, these old muzzle loaders could be fired about once a minute—for short periods.

In the 1939 maneuvers, the smaller forces employed were armed with 120 seventy-five-millimeter guns, having a range of 12,800 yards and the ability to hurl twenty-five shots a minute—with extreme accuracy. Then there were thirty-six 155-millimeter howitzers with a range of 15,400 yards, firing two shots a minute with ease; and twenty-four anti-aircraft guns.

Infantry troops employed twenty Stokes-Brandt mortars, each capable of hurling thirty eighty-one-millimeter high-angle shells a minute at a maximum range of 3,300 yards; and twenty thirty-seven-millimeter guns, carried on light hand-drawn carts. These little guns, extremely effective against tanks and machine-gun emplacements, have a range of 4,500 yards, and can be fired thirty-five times a minute. That's a total of nearly 5,000 explosive shells a minute, as against a possible forty-eight at the first Bull Run.

The Civil War troops carried about 50,000 muzzle-loading, single-shot rifles, deadly at 500 yards, and with an extreme range about double that. Highly trained troops could reload and fire such arms twelve times a minute, but most of the soldiers at the first Bull Run were the rawest of recruits. Four aimed-shots a minute would be an extremely generous allowance for them.

First army troops at the 1939 maneuvers carried 9,044 Springfield rifles, with which ten aimed-shots a minute can be fired with ease. This rifle has an extreme range of 5,500 yards, though few men can see well enough to hit anything with a rifle at more than 1,200 yards. Then there were 1,120 automatic rifles capable of discharging 150 rounds a minute, and 559 machine guns firing 600 shots a minute—a total of nearly 700,000 rounds every sixty seconds, rounds which kill at much greater distances. Many of the machine guns were carried in the seventy-six light tanks,

(Continued to page 125A)

Portable Two-Way Radio Worn by Policeman



Rear and front views of two-way radio. Transmitten and receiver hang on right side, batteries on left

Police in New York are testing a portable transmitting and receiving radio set that can be slung over the shoulder and carried by the officer like a knapsack. The set weighs five pounds, costs \$109 and is worn on one side suspended by a canvas strap. On the other side are carried two batteries. The policeman talks into a microphone pinned to his vest, and one earphone is attached to a headpiece. At present the set has a radius of only 200 feet, and its use will be confined largely to cases where police have provided a "plant" to trap their man.

Rolling Blotter Moves over Paper without Smudging Ink



With one stroke of a rolling blotter, designed to fit the hand, the entire writing surface is dried without moving the paper or causing the ink

to smudge. Rolls consisting of forty layers of blotting paper are available for refilling the holder, one such roll being sufficient to outlast many ordinary blotters, according to the manufacturer.

Welder Rides in Weird Light as He Fuses Aqueduct Pipe



wo sheets of steel are rolled into half-cylinders, then a welder rides his machine through the tunnel and fuses halves into pipe for aqueduct

Grotesque in the lights and shadows of his own machine, welder rides his electric steed through pipe destined to carry Colorado river water to southern California. Here the electric arc, guided by this "midget motorist," converts three-eighths-inch steel plate into pipe of fifty-one-inch

diameter. Rolled first into half-cylinders, the two halves are then fused together by the automatic arc welder. Thirteen and one-half miles of this pipe were fabricated.

Detector Finds Metal in Logs and Saves Saw from Damage

Many a lumber-mill saw has been smashed, sometimes with fatal results, by spikes and other metal buried in logs. To safeguard the saw, the U.S. Forest Service has developed a portable detector consisting of an exploring coil that sets up a howl when it is held near a log in which metal

is imbedded. By moving the coil and listening for the peak of the howl, the exact location of the hidden metal can be determined. The need for such a detector arose in the salvaging of timber blown down in the 1938 New England hurricane, when a high percentage of the timber was found to conceal old spikes, fence nails, hammock hooks, sugar-sap spouts and even parts of scythe blades.

Oil Burner Baffle Prevents Loss of Heat

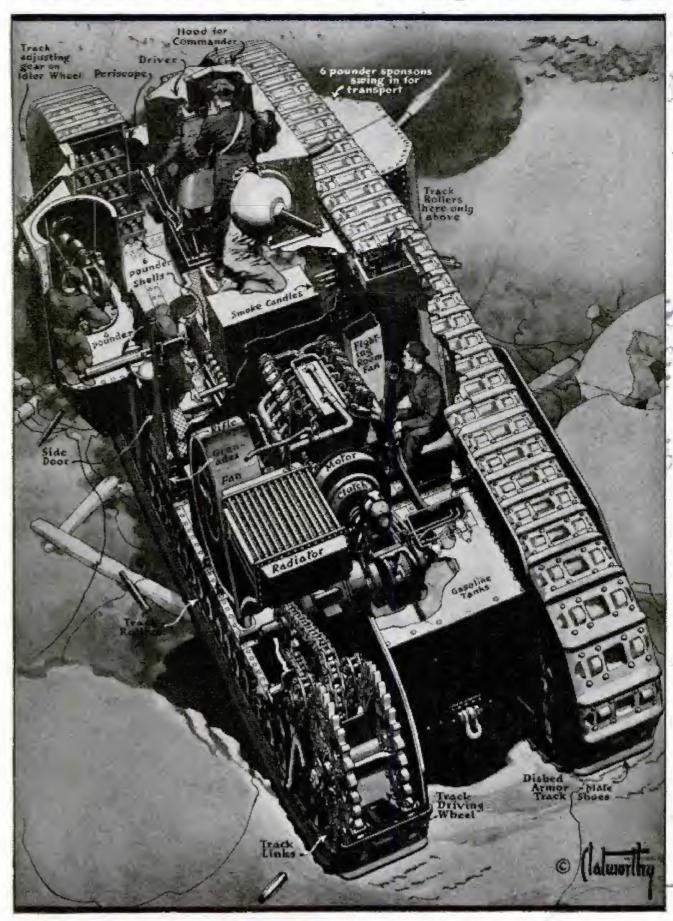
Extra heat from an oil burner can be obtained through use of a baffle. It has adjustable legs which support it above the combustion chamber, deflecting the hot gases against the furnace or boiler wall and thus helping to extract extra warmth before the gases escape up the chimney. The coneshaped baffle is made of high-temperature alloy. Its top heats quickly and gives a radiant effect. Cleaner burning of the fuel is said to result from use of the haffle.



Left, how heat waves are deflected. Right, the

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Thirteen-Gun Tank Is a Rolling Dreadnaught



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Here is a glimpse inside Britain's thirty-seven-ton rolling fortress. Manned by crew of eight, it carries two six-pound guns with 208 shells, seven machine guns with 13,200 rounds. Thirty-four feet long, the tank could span a thirteen-foot gap. It has a 300-horsepower engine fed by a 200-gallon gasoline tank

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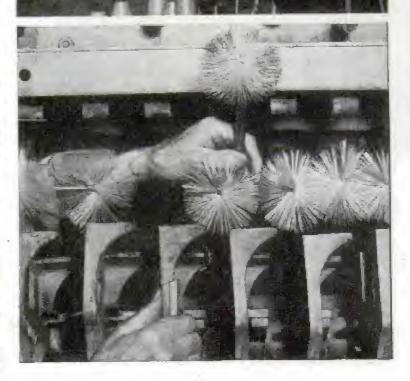
Carn

Bristles of hairbrush, left, are made of nylon; tough, resilient, they outwear any natural bristle. Below, processing nylon yarn; here the machines twist a "bundle" of filaments into thread. Bottom, brushes with nylon bristles used for cleaning bottles in bottling plant

IF YOU say there are no frontiers left for Americans to explore, you haven't heard about nylon.

Columbus wasn't hunting for America when he discovered it, and the research chemists who pioneered the way to nylon weren't looking for a magic yarn that would revolutionize the textile industry and a few others besides. They were not interested in stockings nor toothbrushes, but in superpolymers. Wondering, as the "pure research" scientist does, why and how certain of nature's tiny building blocks, the molecules, united to form the giant molecules called superpolymers, they developed a new type of synthetic material from which fibers of remarkable strength and elasticity could be spun. They called it nylon.

Nylon fibers have a higher strengthelasticity factor than corresponding fibers of cotton, linen, wool, silk or rayon. Truly elastic nylon yarn will return to approximately its original length after being stretched for days. Water can't hurt it, and it dries quickly; most chemicals and oils are harmless to nylon. It's no home



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a NEW YARN

for moths, nor for the fungi that start mildew. The nylon family has some admirable traits, and while it has practically no past its future is bound to be brilliant.

Perhaps you haven't made the acquaintance of nylon, but you can't escape it long. It was announced at the du Pont laboratories October 27, 1938. Commercial production of the yarn has just begun. But in its first year of life, nylon, produced in a "pilot" factory of the du Pont company, has been launched on a versatile career in the forms of fishing lines and leaders; surgical sutures; bristles for toothbrushes.



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Sheer hosiery of nylon yarn, top. Drawing in center indicates random arrangement of molecules in section of undrawn nylon fiber (left) and orderly lineup of molecules after drawing (right). Bottom, control panel which maintains precision in nylon processing

hair and clothes brushes; thread and hosiery. Tomorrow you may find it in rugs and bathing suits, upholstery and parachutes, sweaters, insulation, linings of men's suits—in fact, almost anywhere that silk can go, nylon can go and last longer.

Will it displace silk entirely? That's what some predicted of rayon, back in 1911; but in 1938, when the United States produced 288,000,000 pounds of rayon, twice as much silk was consumed as in 1911.

In the simplest terms, nylon is a combination of coal, air and water. It is a proteinlike chemical, somewhat resembling silk, hair and wool in composition, but actually unlike

(Continued to page 114A)

POPULAR MECHANICS

Light Beam Pries Secrets from Upper Air





Photocell on mirror, top, receives beam of light from sky which emanates from searchlight, bottom

To bring down the atmosphere's secrets from altitudes higher than stratosphere balloons can soar, scientists of Carnegie Institution are playing a searchlight beam into the sky and studying its behavior by means of a mirror and photoelectric cell. In order to distinguish it from ordinary light of the night sky, the beam was made to flicker about ten times a second by an automatic Venetian-blind type of shutter. Located some three and one-half miles away, a large mirror facing upward caught the light from the beam and focused it upon the photocell. The current thus generated was amplified by a special radio amplifier, and from the angles of the searchlight and the receiving mirror the altitudes at which the beam is studied can be calculated. Preliminary experiments

indicate that studies can be carried out to determine the height of water vapor in the atmosphere, the amount of turbulence, the winds, dust, fluorescence and absorption of the sun's rays at altitudes up to nearly twenty miles. From actual measurements it was found that the beam itself could be detected as high as 24.8 miles. This is the "no man's land" of the atmosphere, being beyond heights reached by balloons, and lower than the radio reflecting layers in the ionosphere. Knowledge sought will be useful in meteorology and may lead to information concerning factors that influence world weather.

Pipe-Pulling Jack Saves Labor of Digging Long Trench

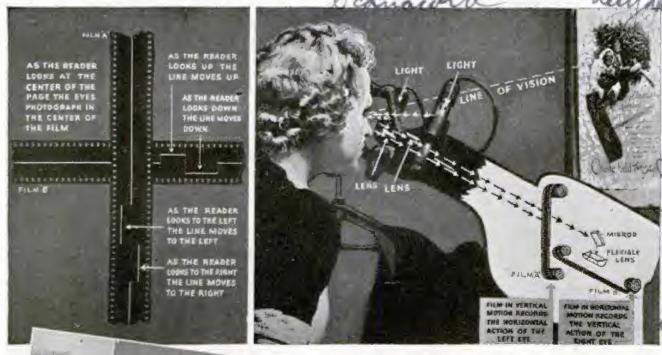
New piping from basement to water main is laid without the labor and expense of digging a long trench by using a pulling jack that "noses" the pipe through without opening the ground. Clamped to the pipe, the tool is said to exert a "break away" power of twenty tons and will handle pipes up to one and one-half inch diameter.



Pulling water pipe through ground with jack saves digging long ditches to reach water main in street

å.

semara & Luces 1630 Eye Motions Filmed to Show Reader Interest



Top, left, tracks on film represent eye movements; right, sketch illustrates operation of apparatus. Below, subject's interest in picture being filmed

To reveal what most attracts attention in a page of advertising or reading matter is the purpose of the Scanacord, a-machine that records on a film all the quick jumps, stops and pauses of the eye as it is fixed on

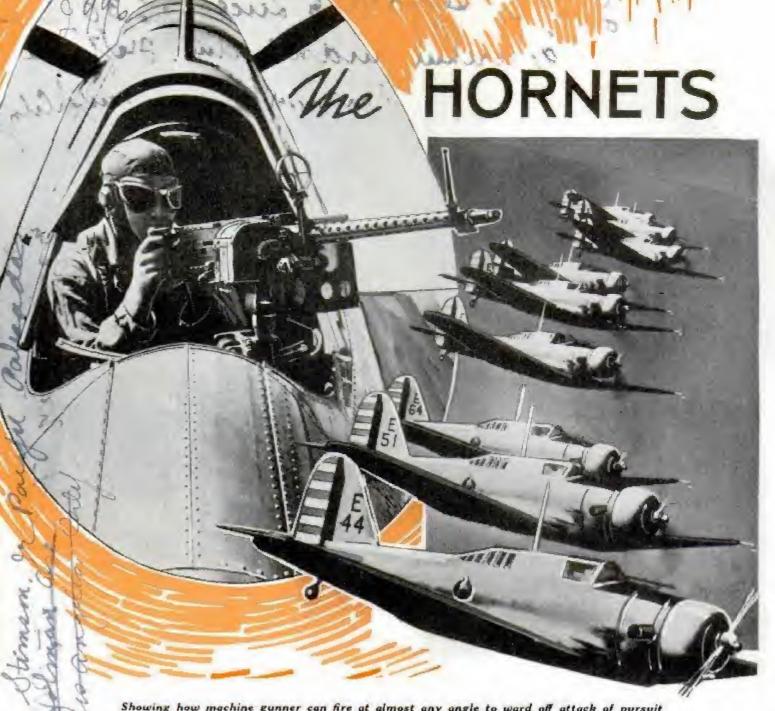
one item after another. The subject sits behind the device while he inspects a printed page on the wall in front of him! As his eyes scan the page, the "eye camera," using the cornea of his eye as a reflector, passes a beam of light onto a slowmoving, sensitized film, thus recording the path traveled by the eyes. When this film, is developed, movements of the eyes are shown in a zigzag track punctuated by black dots, and by placing this over the page, one is able to see what ground was covered in the reading and where and how the eye as it is fixed on long the reader paused at different places.

heels Built in Plane Pontoons Make Light Amphibian

Just as much at home on land as in the water, a lightweight plane is equipped with both pontoons and wheels. The wheels are built into the pontoons and there is a pair of unusual skids in front. The pilot can take off, land or taxi on either water or land.

Amphibian plane, right, is at home both in water and on land





Showing how machine gunner can fire at almost any angle to ward off attack of pursuit planes (left), and squadron of attack planes (right). On crossing "enemy" line the ships descend to a few feet above ground and fly straight toward their objective

pursuit and bombing pilots shake their heads when they watch a flight of attack planes skim over the ground at three or four miles a minute.

Hugging the ground so closely that they sometimes have to zoom upward for room to bank their wings in a turn, attack pilots play a game of hide-and-seek with the enemy. They strike without warning and are gone in a flash. They fly around hills instead of over them to avoid being seen. and when possible they fly upwind to keep the sound of their motors from giving away their approach.

Their object is to harass the enemy and keep it in a state of alarm, to destroy air-

AZARDOUS as are their own jobs, planes on the ground, and to raid antiaircraft defenses as a preliminary to heavy bombing attacks.

Four machine guns, two in each wing, lay a sweeping barrage on the ground in front of a Douglas A-17A attack plane when the pilot presses the master trigger. Fragmentation and small demolition bombs in the racks can be dropped singly or in groups. In the rear cockpit a gunner watches aft against pursuit planes that may sweep down on the plane,

At March Field, Calif., a squadron commander of the 17th Attack Group outlines a typical mission to his pilots.

"We assume that an enemy airdrome has been established on dry Red Lake in northof the AIR CORPS



after taking off."

Then, from photographs

rushed to him from observa-

Top, left, pilot giving last-minute instructions to gunner before taking off on a practice flight. Right, pilot in attack plane repeating radiophone orders to squadron commander. Center, examining machine guns projecting from wing of fighting plane. Bottom, Peruvian ship modeled after early Army Air Corps plane



Top, pilots studying flight orders. Center, machine gunner in rear cockpit of attack plane preparing for target practice against small balloons as plane rockets past them. Bottom, pilot sighting along telescopic sight that is lined up with four machine guns at point in front of plane where their fire converges

tion planes the commander traces the path that the squadron will follow, deciding on the "initial point" where the three flights will split up for their attacks, and arranging a time schedule so that each element will attack immediately on the heels of the last. Leaving their home field, the planes take off in groups of three with only a few seconds between each group. This gets more airplanes up into the air faster than would be possible with single take-offs.

The surprise and whirlwind fury of their arrival are the attack planes' best defense. They are on their target almost before the defenders can decide from what direction the _ sudden roar of motors is coming, and they are over the hills and out of sight again only a few seconds later. About the only defense against them is a ring of machine guns with the gunners steadily on the alert, under a constant tension that makes for poor marksmanship.

The attack planes are hard to see from above and they fly so low that observers only a mile or so away may fail to spot them. The pilots are trained like Indians to take advantage of every dip and fold in the terrain. They fly more by check points than by compass, even on flights several hundred miles long, and every inch of their exact route has to be worked out meticulously ahead of time. Their idea is to fly straight to the target and across it POPULAR MECHANIC

with no time wasted in maneuvering for position. In bad weather they fly "contact" under the clouds and close in, wing tip to wing tip, to follow their leader when visibility is reduced.

Neutralizing anti-aircraft defense would be their most dangerous work in actual warfare because on such a mission they purposely offer themselves as targets in order to locate the defenses and try to;destroy them. On a night raid they go out ahead of the bombers to tempt the defenders to turn on the searchlight beams. Then their task is to put the searchlights out of commission with machine-gun fire. Only daytime raids their job is to lay smoke screens through which the defenders can't aim their guns and to make such a noise with their motors that the mechanical ears on the ground can't pick up the fainter hum of the high-altitude bombers.

One of the unusual hazards of the attack service is that if a pilot is careless he can be blown up by one of the bombs he has just dropped. Depending on the size of the missiles they drop, the pilots fly at altitudes of from 100 to several hundred feet when releasing bombs, giving them time to vget far enough away to feel nothing but a sharp jar and lift to the planes as each bomb explodes. The latest idea is to use parachutes to lower bombs from minimum altitudes. A small parachute automatically opens when a bomb is released from its rack and serves to drop the bomb at a slower than normal speed. This permits more accurate target work and gives the plane a chance to escape even when it is flying only fifty feet above the ground.

In the air a pilot is too busy to give a second thought to his hazards. Over his own territory he flies at a safe distance from the ground but by the time he is in "enemy" country he has descended to just above the tree tops. The ground at each side and below the plane is nothing but a blur and the pilot keeps his attention directed forward. Besides flying his own plane he has to keep his place in the formation and watch the leading plane for signals. During the day the leader signals by wagging his wings or tail, and after dark by flashing groups of small blue signal lights on his fuselage and stabilizers.

Attack pilots get special training in effi-

(Continued to page 126A)

Umbrella Holder for Auto Clamps on Steering Post







Sheathed in a socket attached to steering post or wall of car, the umbrella is handy for a rainy day

Umbrella holders that can be installed in the car in a few minutes are keeping motorists prepared for rainy days. The eleven-inch "scabbard" is clamped to the steering post or screwed to the side walland does not interfere with driving.

Self-Cleaner for Your Old Rake Removes Matted Grass

Fitting many of the old sixteen-tooth, standard rakes, a self-cleaning attachment strips the teeth clear of matted grass and twigs by merely flipping the rake on its



back and preseing on the handle. A metal scraper bar, perforated with six-

teen square holes that fit snugly over the tines, is fastened at the ends to a spring-steel bow secured to the rake handle by means of a small loop. This bow forces the cleaner bar against the back of the rake so it will not interfere with normal use. The attachment can be slipped off the rake easily when not needed.

the problem to

Phone in Fireman's Mask Aids in Giving Orders



Fireman wearing gas mask can enter smoke-filled rooms and telephone instructions to his men outside

Firemen are aided in fighting fires in smoke-filled interiors by a combination gas mask and telephone. With it a fire fighter can enter a burning building and give instructions for fighting the fire to those outside.

Vibrationless Diesel Engine Jiggles to Balance Piston

Differing radically from previous designs for a vibrationless engine, a singlecylinder, ten-horsepower Diesel engine created by a Swedish engineer delivers power with virtually no vibration. The main part of the motor body, having been transformed into a mobile counterbalance for the piston movements, serves to com-

pensate the power impulses by its own jiggling motion. The majority of efforts to do away with vibration centered about multi-cylindered engines in which the various moving parts compensated each other. Installed in a boat, the new Diesel has given almost perfect compensation for both the reciprocating and rotating parts as well as the power impulses.

Auto Converted into Sleeper by Folding Seats

You can convert your sedan into a bed by replacing its present seats with others that may be changed into a single or fullsize double bed fifty-four inches wide and seventy-six inches long. The equipment consists of two front seats and a rear seat, and only simple maneuvers are needed to change them quickly into a bed, or back into seats. With the right seat made up as a single bed, two drivers can take turns sleeping and driving or the bed can be used as a couch for transporting sick or injured persons. The double bed turns the interior of the car into a sleeping berth, roomy enough for two. Both front seats > can be reclined separately at any angle.

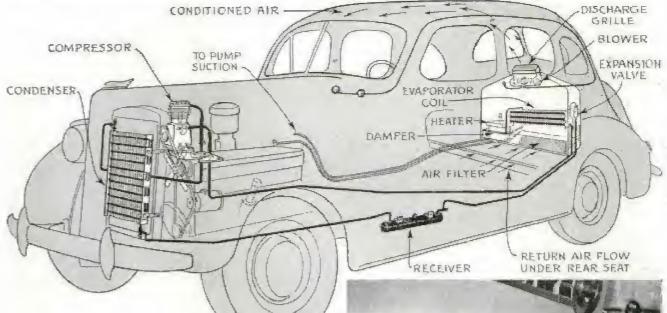


op, made up double, bed holds two people. Bottom, single bed to right does not interfere with driver

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POPULAR MECHANICS DO

Auto Air Conditioned for Summer and Winter



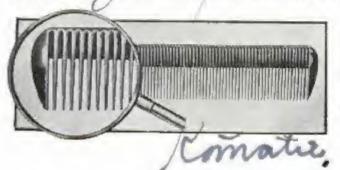
Air conditioning for automobiles, which includes cooling in summer and heating in winter, as well as filtering and dehumidifying, is being built into Packard sedans as extra equipment. Air is cooled by a refrigerating plant, similar to that used in household refrigerators, and its moisture is condensed as it passes over coils that are defrosted automatically. The refrigerator coils are, located behind the rear seat in an air duct, which also contains the winter heater in a separate compartment, and two dampers easily reached through the trunk are opened and closed to select hot or cold air. Drawn into the duct by a fan, the speed of which can be varied by a switch on the instrument panel, air is filtered before it passes over the cooling coils, and the treated air is discharged through a grille above the rear seat toward the roof of the car, whence it is distributed naturally over the entire interior, entering the duct_again under the



Top, sketch shows installation of automobile air-conditioning equipment and how both warm and cool air are circulated. Bottom, compressor mounted over engine is run by auto fan

rear seat. The compressor, mounted on top of the engine, is driven by the radiator cooling fan, and the refrigerant is admitted through an expansion valve to the coils. Its cooling capacity is rated at one and one-half tons of ice in twenty-four hours, at a car speed of sixty miles an hour.

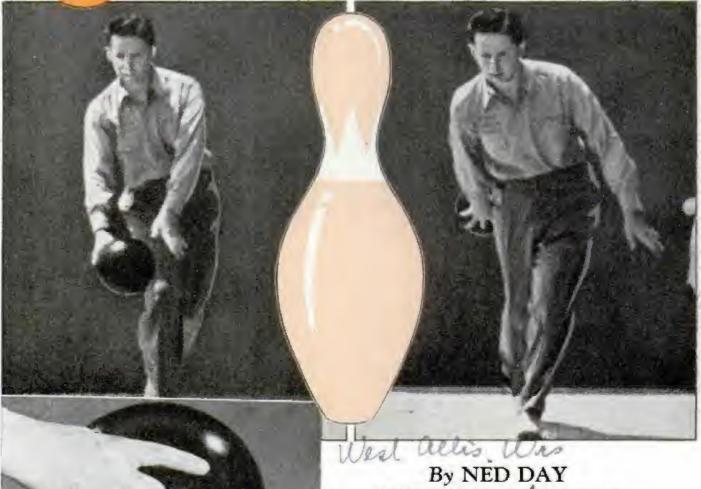
Teeth of Comb That Cleans Itself Extend Clear to the Backbone

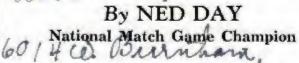


In addition to being designed to clean itself, it is claimed by the manufacturer that a new comb will hold three times as much wave-setting solution, will increase the life of permanent waves, and will not pull the hair out nor tear it. The teeth of the comb extend clear to the backbone.

are newyork

ROLLING UP the





I F YOU'RE weary of sitting in a stadium watching someone else grow healthy, try bowling.

Here's a sport that's more fun to play than watch, where the emphasis is on individual participation. Wherever it's played you'll find a dozen bowlers to every spectator. This is borne out even in bowling's world series, the American Bowling Congress. More than 25,000 bowlers from all over the country take part in the fifty-day classic, but the box-office receipts seldom amount to one-tenth the sum the contestants pay in entry fees.

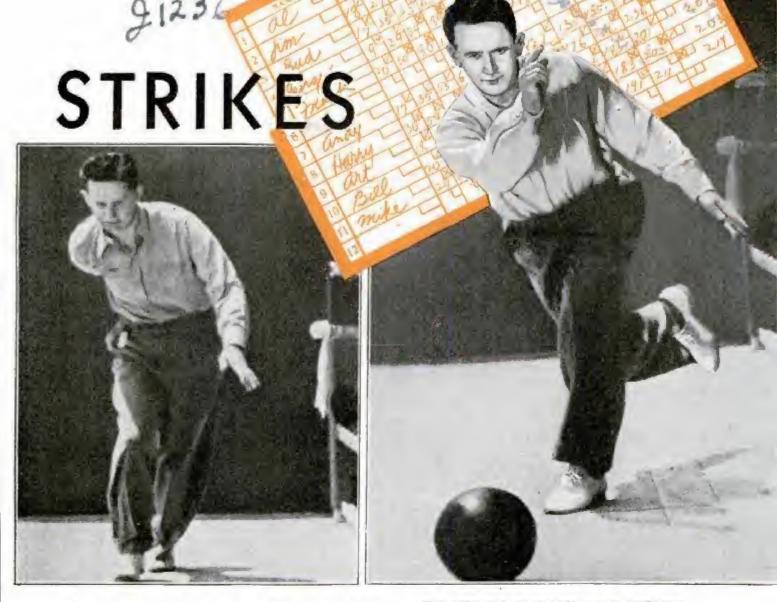
The bowling army pays its own expenses just for the privilege of getting a crack at sixty per cent of its own money. In the aggregate this will amount to a tidy sum, approximately \$200,000; but nobody will go home rich because the amount will be split about 8,600 different ways so that one out of every four entrants wins a prize.



Left, center, three-finger Ned Day grip, a new development that is said to import uncanny accuracy to a hook ball. Bottom, fingers on the outside of the ball should be held in a natural manner

Cornalis

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The richest plum in the singles event, for example, will net the winner \$300.

A more astonishing picture of sports participation is the \$50,000 Red Crown Sweepstakes in which 250,000 bowlers under ABC sanction compete on their respective home alleys prior to the congress.

Bowling is truly a national game. It's good exercise, though not of the violent character, and it's mentally exhilarating. And because the general theory is to shove, not blast the pins into the pit, mere physical strength isn't nearly so important as timing, rhythm and control. There's a good deal of skill in rolling a high score, but it's not the exacting skill that causes the beginner to give up in despair.

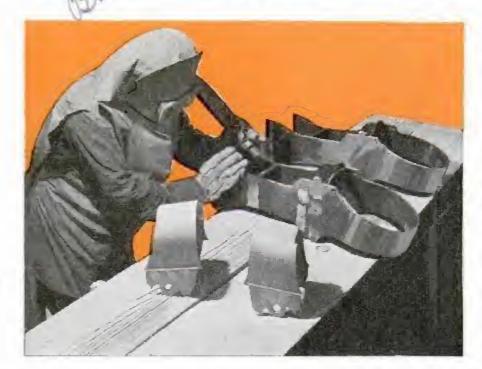
The number of players, or keglers, is estimated at 12,000,000, and a check of the different types of devotees lends credence to this figure. During the last several years, there has been a rapid upward swing in the number of industries and organizations installing bowling alleys on their own premises. One New York manufacturer has 140 teams that roll on company-owned alleys.

Top (starting on opposite page and continuing on this), first step, with right foot, ball descending, right arm straightening, body balanced; second step, with hand turned in front of ball, arms straight; third step, with ball at top of back swing, body beginning to bend forward for glide, and, fourth step, a glide and the delivery. Note follow through. Right hand indicates top spin has been applied. Below, pencil test shows whether ball has correct span



POPULAR MECHANICS

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while an insurance organization makes use of twenty-four public alleys two nights weekly. The growth in feminine interest is shown in the fact that several large firms have more women bowlers than men, and in Chicago, a hotbed of bowling interest, as many as 8,000 roll in the women's city championship.

Many clubs have installed bowling facilities at the insistence of their members. So have hundreds of churches, an outstanding example being the Riverside Baptist in New York, where its chief benefactor, John D. Rockefeller, Jr., is among the regular group of financiers who use the five alleys. In Hollywood, bowling is popular and many actors have bowling alleys in their homes.

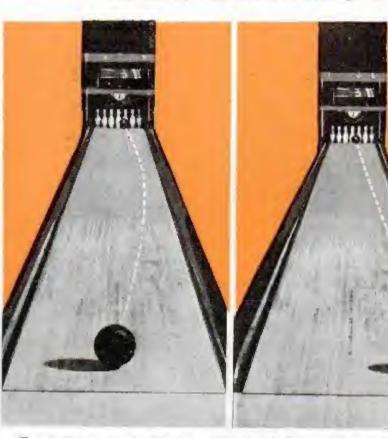
That the sport bridges physical handicaps is demonstrated whenever a team from the New York Guild for the Jewish Blind engages in a match with players of normal sight. A handrail on the left side of the alley that serves to guide each player on the approach is the only concession given the sightless. When any pins are left standing after the first ball, the pin boys call them out

and the rest is up to the player. In competitive matches, some of the blind youths have rolled scores above 140.

On his first visit to an alley, a novice upon hearing such expressions as spare, railroad, cherry pick and baby split is apt to conclude that bowling is a complicated game. It isn't. You simply try to knock down ten pins, set in the form of a triangle and weighing about thirty-three pounds, by rolling a sixteen-pound ball—or a lighter one if you wish—down a sixty-foot

white maple alley with the aid of speed, timing and control.

Frequently, a 134-pound bookkeeper with no apparent athletic ability will join an office league and within a short time be rolling good scores. There's no reason why the erratic player or the run-of-the-mine dub cannot improve his average if he's



Top, ball returns about to be sandblasted in Brunswick factory. Bottom, left, curve ball is played from near alley center and thrown out toward gutter, but it eventually hits 1-3 pocket. Right, straight ball, which is easiest to roll and control, takes straight course from right corner to 1-3 pocket

POPULAR MECHANIC

willing to take stock of his game.

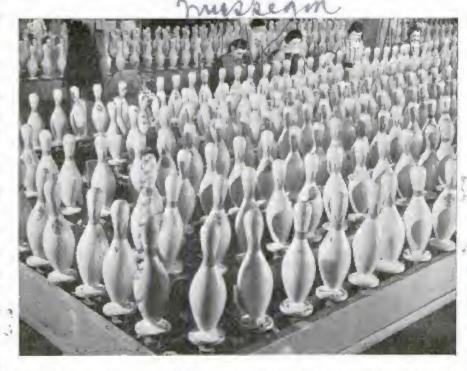
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When you bowl with an ill-fitting ball you'll never get any better. Instead of having a ball with the thumb and finger holes of the proper size and so spaced as to provide the correct span, many players, at the expense of their games, persist in using a grip so narrow that it is impossible for them to hold the ball without having their thumb so deep in the hole that it's carrying all the weight. The weight of the ball should be distributed

evenly between the thumb and fingers, so don't let anyone sell you on the idea of using a short span ball, that is, one with the holes too close together, otherwise your hand will be in a cramped position and the

ball won't be properly balanced.

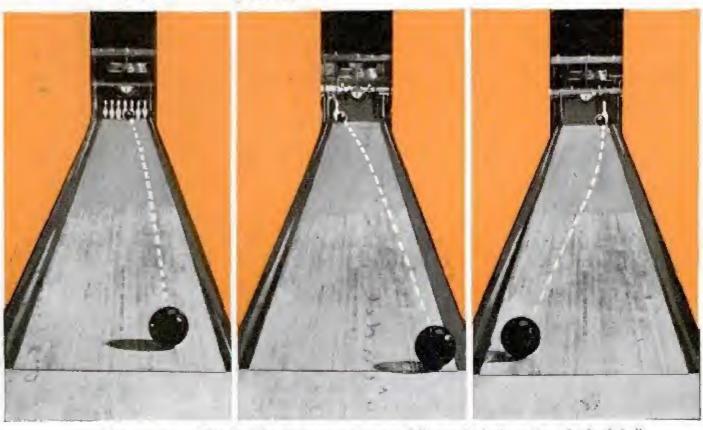
Remember, in holding the ball, the index finger is for balance, the middle finger must share the weight of the ball and



impart spin to it, while the ring and small finger assist on the follow through.

An easy way to make sure you're using a ball with the correct span is to allow enough bridge between the palm of the hand and the surface of the ball for the insertion of a pencil which may be rolled over several times freely in this space.

(Continued to page 140A



Top, moving production line in factory. Bottom, left, greatest pin getter, the hook ball, is dropped eight or ten boards in from right-hand gutter. Center, how to make that seven-pin spare. Right, nothing to the ten-pin jinx when it's handled like this

POPULAR MECHANICS

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Electric "Eyes" Count Gate but Skip Those Going Out



Photo-electric "eyes" in panels at sides of door and overhead scan visitors and count attendance

An attendance register built to watch the "gate" for movie houses, skating rinks and the like seems able to think with its photoelectric brain. It will count persons entering the door and yet ignore those who go out by the same door. When you go in, your body cuts off light beams between double windows in metal pillars at each side, and the counting device checks you in. Going out, however, you aren't counted. If two persons walk in side by side, light beams from overhead spot both. And if someone holds his hand in the beam to stop its normal operation, the register lights a signal in the manager's office.

Five-Millionths Inch Measured by Electric Micrometer

Measurements as small as five-millionths of an inch are indicated by a special radio tube that converts any microscopic displacement of its detecting rod into a proportionate flow of electric current. This current goes through a microammeter and

the deflection of that instrument's needle indicates the measurement of the original displacement. The electrical micrometer is a radio tube consisting of an electronemitting filament and two tiny plates, insulated from one another and jointly supported by a rod which goes into an elastic diaphragm fixed in the bulbous part of the radio tube. Outside the tube, and attached to the diaphragm, is spot welded another small rod whose job it is to detect tiny displacements. Slight displacements of this rod, communicated through the diaphragm, bring one plate nearer to the filament and the other plate farther away, resulting in a decided difference in flow of electrical current, proportional to the displacement.

Looseleaf File for Photo Films Holds Twelve Slides in View

Twelve transparencies can be mounted on every page of a looseleaf filing system for miniature photograph slides which offers easy access for viewing. By holding the panel in front of a table light the twelve slides can be examined at once. Each two-by-two transparency is individually housed and protected from handling.



Placing photo slides in cardboard panels for viewing in front of lamp; panel fits in looseleaf book

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POPULAR MECHANICS

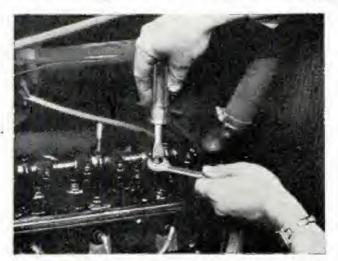
Garden Greenhouse in Sections Easily Set Up

Anyone can build his own garden greenhouse with sections which are delivered ready for quick assembly. No special skill is required in bolting them together and fastening them to the foundation. The foundation consists of heavy rot-resistant plates with stakes to anchor them to the earth. Side panels and roof sections are assembled with brackets, being joined together at the peak by pin hinges, and fastened to the foundation by hooks and eyes. Framing material is made of red cedar coated with aluminum paint. A site need never be regarded as permanent, since the building remains portable. Also additional sections may be purchased to enlarge the greenhouse. With clear glass from the roof peak to within three or four inches of the ground, there is virtually no shaded section inside. Children can use the greenhouse as a solarium, and the experimenter finds it a good place for raising chemical gardens. Heat can be piped into it from the home heating plant or special heaters are available.

Top, right, door is added after two side sections are on foundation; center, finishing with end frame and door; bottom, greenhouse completed



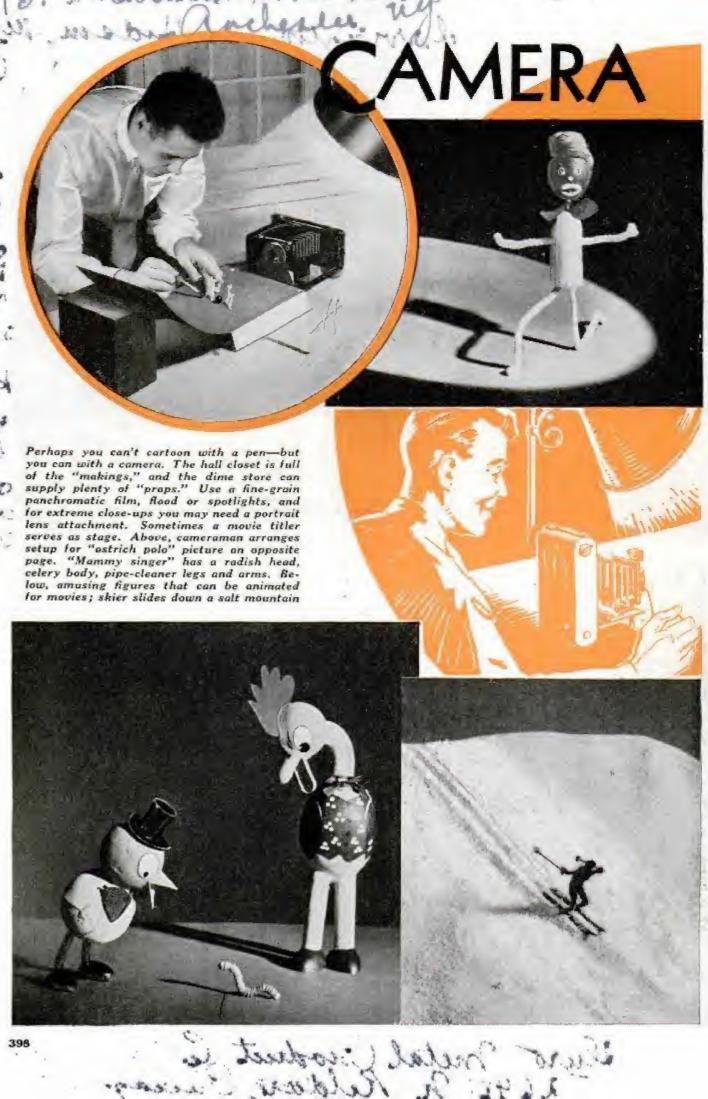
Dancing Blade Adjusts Tappets While Engine Is Running



Spring in handle permits blade to ride with tappet

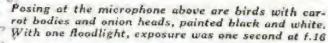
Tappets on overhead valves are easier to adjust while the engine is running, with a tool that follows the up-and-down motion without transmitting it to the handle. Its blade retracts into the breakproof and shockproof handle when the tappet rises, and a spring forces it out as the tappet is lowered, thus leaving the hand steady for making the necessary adjustment.

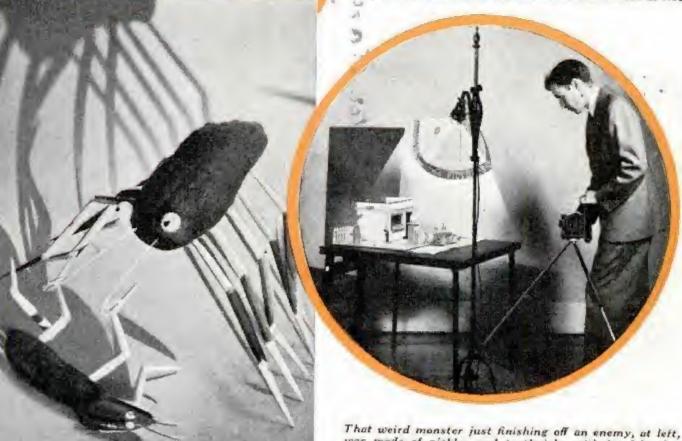
 Names and addresses of manufacturers and dealers in articles described in this magazine will be furnished by our Bureau of Information upon request accompanied by stamped, self-addressed envelope.



CARICATURES







That weird monster just finishing off an enemy, at left, was made of pickles and toothpicks with bead-headed pins for eyes and antennae made of fine wire. Above, a simple arrangement for table-top scene of gas station

W. Q. J. S. C. Conna

Blanket Is Worn Like Robe If Air Raid Comes at Night



Bed cover, left, is quickly converted into hooded robe, right, for dash to shelter in night air raid

When Londoners are awakened in the middle of a chilly night by air-raid warning sirens, a wartime blanket which can be converted quickly into a robe enables them to hurry into their outdoor shelters without losing time or warmth. Sewn at one edge of the coverlet is a hood that slips easily over the head, and there are drawstrings at the neck.

Crossbar on Hexagonal Wrench Opens Drain Plugs Easily

Two-handed leverage can be applied to a wrench with a crossbar handle designed to ease the operation of opening tight oil-



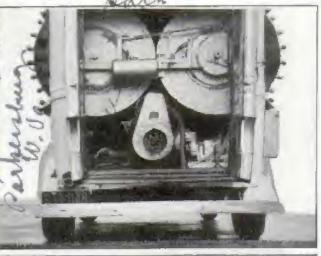
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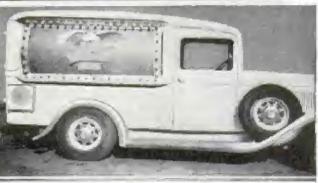
Tight drain plugs open easy with this crossbar tool

drain plugs. The tool has two hexagonal openings, one measuring two inches and the other fifteen-sixteenths. It is especially useful on some of the smaller cars.

Signs on Sides of Truck Change as Messages Are Broadcast

Eight different advertising messages are delivered in both sound and pictures by a sound truck equipped with two rotating cylinders mounted lengthwise inside the body. Side panels of the truck are cut open to provide a two-by-five-foot space through which the cylinders protrude, exposing one-fourth of their surface. Each cylinder bears four signs that appear in the





Top, rear view of cylinders in truck. Bottom, sign at side, rimmed with lights, changes as roller turns

openings, one at a time for twenty seconds, an announcement relating to the sign, picked up from a phonograph record, being broadcast simultaneously. A 500-watt alternating-current plant furnishes electricity for the light bulbs around the sign spaces as well as power for the twenty-watt amplifying system. To turn the cylinders, a shaft running the full length of the truck gets its power at the cooling fan of the engine.

Telephone Dial Steers Radio-Controlled Boat



Left, radio-controlled boat responds to orders transmitted by short-wave impulses. Below, operating new telephone dial that is used for selecting the proper impulses to send in executing any given maneuver

Operation of a radio-controlled boat is greatly simplified by the development of a speed and direction selector that is manipulated like a telephone dial. In tests made at Franklin Institute a five-foot scale model yacht was steered about in a tank and its speed regulated entirely by dialing the short-wave radio impulses, which were picked up by a receiver in the model.

Metal Parts Nailed Together by Clip That Spreads

Metal parts are virtually nailed together with a tubular clip of spring steel which spreads after being driven home. At opposite sides are two cam-like tongues that



spring out, firmly locking the clip in the hole. A flange at the end performs the service of a nail head. To make it more secure, a stud is inserted to fully expand the curled-in end of the clip.

forming a double lock. By forming the clip with the correct degree of "bite," it can be adjusted so any predetermined amount of "pull" will remove it. It is not necessary to have access to both sides of an assembly, as is the case when bolts are used.

Four-Lane Road "Jacked" Apart to Form Safety Center Strip

Fatal accidents on a New Jersey fourlane highway were reduced more than eighty-three per cent by the novel method of splitting the road lengthwise and jacking the concrete slabs apart to form a dividing center strip. Accidents of all kinds decreased forty per cent after the two-way division was effected.

¶Send return postage to our Bureau of Information to learn the name of the maker of any device described in this magazine.

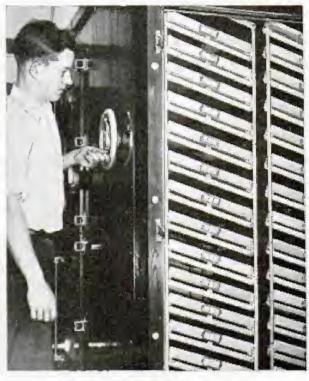
MAKING MONEY with



SHE used to live in the country, where she had to scratch around for a living and turn over her meager and irregular earnings to the farmer's wife to buy Easter bonnets and make down payments on the new sewing machine.

Now the hen has gone to town. She has sacrificed the freedom of the farm—if you call it a sacrifice —for the social security of a one-room apartment in a skyscraper of wire cages where there is nothing to do but listen to the radio, eat and lay eggs. Thousands of suburbanites and city dwellers have put millions of hens to work on the production line in back yards and basements and idle factory space.

You see, there's money in it. You can figure on, roughly, \$2.50 a year, clear, from every laying



Photos courtesy M. H. Arndt Mig. Co.
Radio music induces hens to step-up production, top. Center, hen looks on as she
gets credit on chart for one egg. Bottom,
turning cranh to clean endless belt that
serves as floor for cages. Right, turning
eggs in incubator

Cliff-Dwelling HENS

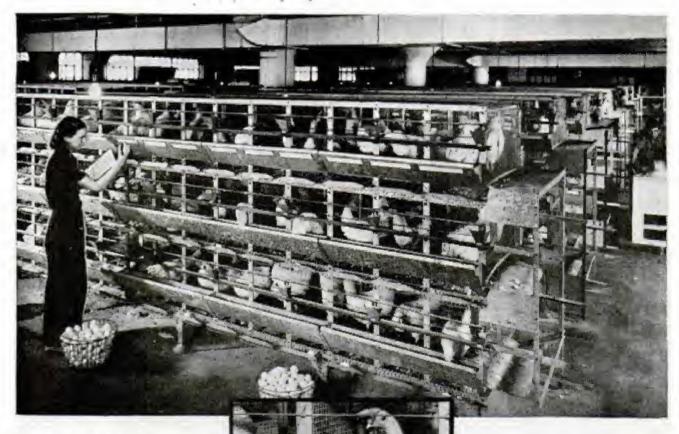


hen. One hundred hens in your basement will pay you \$250 rent. A thousand caged in a backyard shed add \$2,500 a year to your income. A hen won't ask much of your time. One man at a college farm spent four hours a week caring for 108 hens; they weren't pedigreed pullets picked for their laying talentsthey were the run of an ordinary flock, and in a year they earned \$298.37, or \$2.77 per bird before deducting the cost of labor. After paying for labor, each hen earned \$2.17.

And you don't need to be a professor of poultry or an experienced farmer



Sorting eggs for market is done quickly and automatically by grader at top. Below, a three-story apartment for baby chicks. In cages three feet by six feet, 200 chicks snuggle for warmth under an "electric mother"



to run an egg factory. Even if your training in the handling of chickens has gone no further than managing a drumstick at Sunday dinner, you can learn what you need to know in a few days at a demonstration farm.

You wonder how a hen can be happy in solitary confinement, with never a grasshopper to chase nor a hen-party to attend,

without sunshine or exercise. Well, you can't interview the hen, but she lays down the evidence convincingly: 21,000 hens in cages on Milton H. Arndt's half-acre demonstration farm near Trenton, N. J., produce fifteen per cent more eggs than the same number of hens that range over Mr. Arndt's ninety-acre breeding farm.

Ten years ago, when Mr. Arndt started his cliff-dwelling hen colony, there were just 1,000 hens in single cages in the United States. Today there are 40,000,000. One of the largest batteries is in an old factory in New England. Another is in a Long Island church. Millions of eggs roll off the production line from cages in a Chicago warehouse; thousands of hens are at home in Manhattan boiler rooms and Detroit

Harvesting eggs on Arndt experimental farm near Trenton, N. J. Notice how the eggs roll into collecting trays out of sight and reach of the hens. Laying hens are housed in individual cages



breweries. A New York delicatessen owner raises broilers in the cellar, roasts them in the kitchen for sale in the store.

These batteries are tiers of cages equipped with feed and water troughs and belts which, turned by cranks, remove the manure—which brings ten cents a bushel—and keep the cages sanitary. Seventy-five per cent of poultry disease is contracted on the hen-house floor or in the barnyard. Life in batteries is healthy.

As soon as it is laid, the egg rolls down the wire floor of the cage to a trap out of the hen's sight, where it can cool quickly. Under each cage is a score card, which is also a death warrant. For every egg, an "X" is marked on the card. And if she loves life, Mrs. Hen had better keep a nice, healthy string of "X's" on her calendar. The moment her monthly output falls below twelve eggs she is doomed to a fricassee. Nine eggs a month pay her board and keep. If she can't hand you a profit of three eggs a month she must be culled, to be served with dumplings while a more efficient layer moves into her room.

Quiet life in a cage produces tenderer, better-flavored meat because diet is controlled, and feed is manufactured into tender meat instead of muscle. On the other hand, imagine the embarrassment of the broiler colony owner who made his first big sale to a hotel for a banquet. The broilers were dressed and delivered the day of the dinner, and the chef browned them in his finest style. Tenderer chicken was never served; but at the first forkful, anticipatory pleasure of the guests faded into dismay. The chicken had a disagreeable fishy taste. The chef was chagrined, the banquet ruined. The meat had been flavored by cod-liver oil fed to the chickens. Omission of the oil from the feed two days earlier would have eliminated the flavor.

If you're interested only in eggs, you can buy matured pullets ready for laying. Or you may run your own nursery, hatching eggs or buying day-old chicks.

To keep egg production at his farm at a high level, Mr. Arndt selects the top five per cent of the layers in his egg factory and sends them to the breeding farm. From there the fertile eggs are sent to mammoth incubators. Millions of chicks are born every year in these orphanages, kept auto-

(Continued to page 122A)

Portable Drawing Machine Fits in a Brief Case



Well-equipped drawing board slips into a brief case

No bigger than a brief case, a portable drawing machine just offered is complete with board, square, triangle, scale, protractor and paper clamps. Its L-square is always held true by a permanently attached semi-universal arm which swings over the entire surface of the board.

Automatic Insulation Stripper Catches Waste in Drawer

Insulation is removed quickly from the ends of wires when they are inserted in an automatic stripper that is completely enclosed to keep from scattering the waste. The length of stripping is adjustable, and insulation scrapings fall into a drawer which can be taken out and emptied.

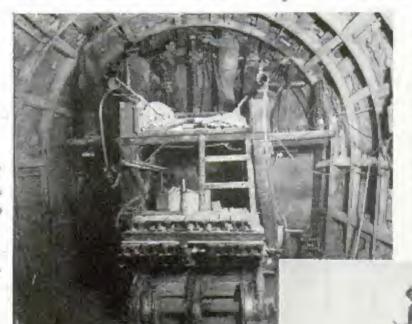


Drawen catches insulation waste stripped from wire,

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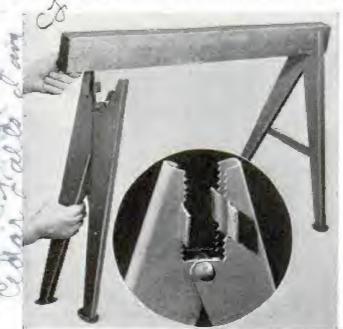
"Machine-Gun" Crew of Five Drills a Tunnel



Machine gunners of peace are the steel-helmeted team of five men who manned the drills boring a 3,925-foot tunnel on the Roza Canal project at Yakima, Wash. The five automatic-feed drifting drills mounted on a Jumbo drill carriage advanced an average of nearly twenty-seven feet per day and on their best day moved forward forty-three feet, driving a sixteen-by-sixteen foot horseshoe tunnel.

Those "machine gunners" at the right are really very peacefully inclined. The guns, mounted on a railway carriage, are automatic drills used in boring the 3,925-loot Roza Canal project tunnel near Yakima, Wash. Above they are seen at work

Folding Metal Sawhorse Legs Need No Nails or Screws



Folding sawhorse leg holds by teeth shown in circle

Sawhorses are easy to set up or knock down when assembled with folding metal legs that can be attached quickly. Teeth at the top bite into any two-inch board regardless of its width, when the feet are spread and the hinged connecting piece is pressed down between them. No nailing is necessary, although holes are provided if permanent horses are desired. They require little space in the car or truck when carried for outdoor use as at picnics to support tables or temporary booths.

Disappearance of Red Salmon Puzzles Canning Industry

The strange disappearance once every five years of red salmon in Bristol bay waters off Alaska is one of nature's mys-

Washing POPULAR MECHANICS

teries. These cycles occur in years ending in zero and five, so experts of the canning industry and of the U. S. department of the interior expect a small run of red salmon in 1940. The average annual catch for the twenty-year period from 1920 to 1939 has been about 15,-600,000 fish. Compared with this, the 1920 catch was 8,897,915, declining steadily every fifth year until 1935 when only 3,154,150 were taken. However, the decline for 1940 may not be quite as much as it has been for preceding years in the bi-decade list. This is because drastic restrictions were imposed on the catching of red salmon in Bristol bay during 1935, resulting in the escape of a larger percentage of fish into the spawning grounds. Salmon return to the spawning grounds at an approximate age of five years, although thus far no definite relation has been noted between the numbers in which they return and the number of fish that spawned five years previously, except in this one mystery cycle.

Portable Airplane "Cockpit" Teaches Use of Aerial Gun



Aerial gun mounted in portable "cockpit" helps train recruits in rudiments of handling rifle prior to practice in a plane

To help instruct classes in aerial gunnery, the British navy's air force has constructed a portable "cockpit" with a gun mounted on it as in an airplane. The recruit thus can learn how to handle the gun before he steps into a ship.

One Man Lifts Three Tons with Lever and Chain "Jack"



More than three tons can be lifted by one man with aid of lever and chain "jack" that has many uses

With his strength multiplied many times through a jacklike lever and chain, one man can lift, lower or move exceedingly heavy objects, stretch cable and fence wire, bind loads, and do many other jobs without undue exertion. So designed that it will pull in any direction from any position, the tool is made in four sizes with lifting capacities up to three and threetenths tons. No power is lost through interior friction because pressure on the lever is transmitted directly to the chain. Two pawls, functioning alternately upon the chain, cannot be released until lever tension is applied, thus keeping the load under the operator's control at all times. In lifting or pulling, the lever is pushed forward until a vertical link of the chain is engaged. Then the lever is pulled backward until the limit of the stroke is reached and the pawl is locked, after which the lever is disengaged by a slight sidewise thrust and the operation is repeated.

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son in advance. In fact

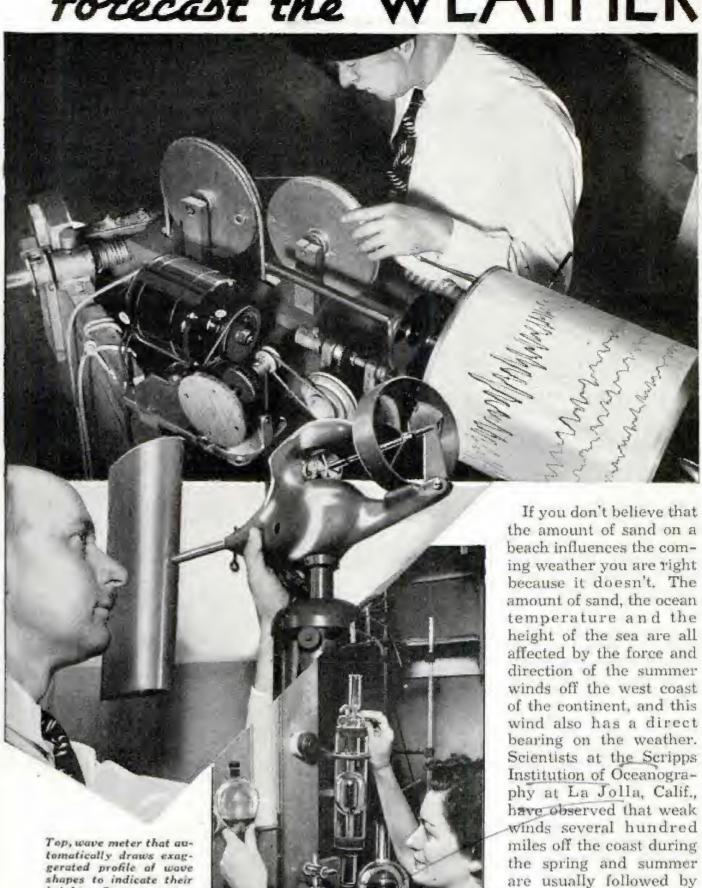
they are doing so now in southern California, using methods that seem absurd until they are explained.

One investigator, after an inspection of beach sand, is apt to announce: "There is less sand than usual on the beach, so there won't be much rain next winter." Another, studying a thermometer he has raised

from the ocean, may declare: "You are right. The water is a little colder than usual." A third scientist, who has been measuring the height of sea level agrees and a fourth, comparing reports of strong winds radioed in from ships at sea, likewise declares that rainfall during the coming winter will be less than average.

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Forecast the WEATHER



heights. Center, current

meter that measures speed of subsurface cur-

rents, Bottom, measur-

ing amounts of gas found

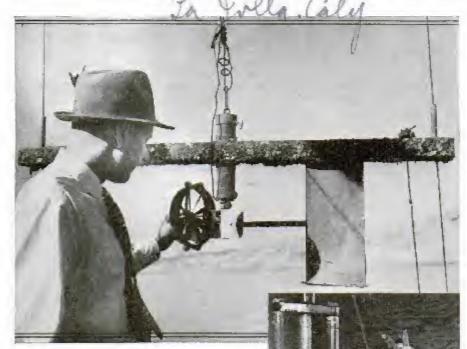
in samples of sea water

excessive rainfall the following winter. The weak winds likewise are associated with high water

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Down Laboratory
POPULAR MECHANICS

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temperatures, sand deposits and a higher than usual sea level, allowing any of these factors to be used as an indication of the severity or mildness of the forthcoming rainy season.

From such observations the oceanographers issued predictions on last winter's weather that at La Jolla was accurate to within half an inch of the actual precipitation for the sea-

son, although the scientists don't expect to be that accurate every year.

Unfortunately for weather forecasters elsewhere, southern California lies in a critical meteorological belt in which a definite cause and effect relationship has been found between summer winds and winter rainfall, an association that doesn't seem to exist elsewhere.

Nevertheless the oceanographers think that the key to coastal climates in most parts of the world can be found in the oceans and that eventually they will be able to anticipate climatic changes. The sun, of course, is the real mainspring of the weather although some of its

Jad .

influence has a delayed action. The sun influences the winds, the winds influence ocean currents and these in turn affect the general weather.

"The characteristics of the ocean currents are known in a general way," says Dr. H. U. Sverdrup, director of the Scripps Institution, "but we know practically nothing about their internal structure. Just like a prevailing wind that really consists of gusts, calm periods, flurries and breezes that blow steadily at times, an ocean current is an average of many small varying water movements, each body of which may have its own individual temperature, salinity, density and direction.

"Each different component of a main current may be formed or dissipated by many confusing

(Continued to page 116A)



Cleaning blades of current meter that measures force and direction of ocean flow past pier (top); taking water sample from tube that brings sample from any depth desired to the surface (center), and lowering group of current meters to bottom from laboratory ship

POPULAR MECHANICS

Cable Laid by Tractors in Double Quick Time



Two tractors in tandem arrangement helped lay cable in double quick time by pulling a rooter converted into a cable-laying machine. Cable was fed into opened ground from huge reel

Four miles of underground cable recently were laid in double quick time by converting a standard rooter into a cablelaying machine. Two ninety-seven horsepower tractors pulled the implements at a speed faster than a man can walk, the ground being opened to a depth of three feet and the cable laid by a feeding device.

Camera Case Serves as a Rest While Making Movies

Redesigned so that it can serve a double purpose, the carrying case of one movie camera becomes a camera rest while making movies. The camera is screwed to a tongue permanently attached to the case, which rests on the chest for steadiness during picture-taking.

Waste Product of Papermaking Yields Profit for Industry

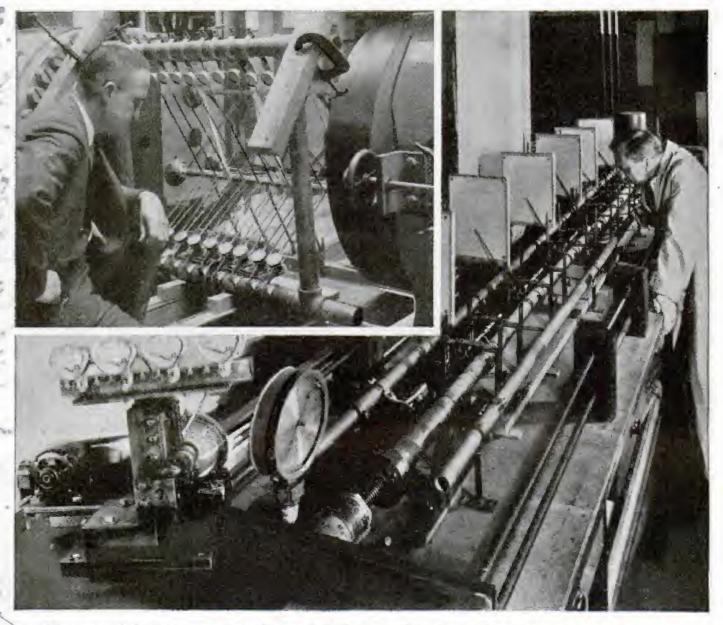
After cellulose is taken out of wood in making paper, there remains a waste product, sulphite liquor, which was once poured into streams. It made them ugly and uninviting, killing fish and plant life. Now sulphite liquor is being mined for its lignin, a substance used in producing certain plastics that find many applications in the building industry and serve also as impregnating resins. In addition to lignin, other useful products come from the waste of papermaking, including sweet-smelling vanillin, the basic constituent of vanilla extract and a tanning extract that makes cement harden more quickly.



Screwed to tongue attached to its carrying case, camera is steadied in position for taking movies

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TORTURE CHAMBERS



Micrometer dials (top) are arranged to study deflection and twist of a short duralumin girder for dirigible under compression test. Below, at left, bicycle speedometers vibrating 1,700 times per minute in shakedown test; right, recording effect of compression on cable sheath

THE things you buy today stay whole because they've been broken, last indefinitely because they've been worn out. Modern industry saves you trouble by deliberately making trouble.

In the Bell Telephone Laboratories of New York is a room full of machines whose purpose you would never guess. One of them performs the "Wrong Number" or "Bill Collector" test, picking up hand sets and slamming them down onto the cradle, just as you and I do when we become angry at the phone. A hundred times a minute it does this, day after day, until a set breaks somewhere. The part that breaks is redesigned to make it stronger. Then the whole procedure starts over again. Pick 'em up! Slam 'em down! until the next part breaks. This goes on indefinitely, until today it is almost impossible for an irate customer to break his telephone without deliberately resorting to the ax.

There is a machine with reciprocating fingers that dial numbers day in and day out, until somewhere the mechanism breaks down. There is a device that slams switchboard plugs against a shelf of steel. There is one that slides a phone endlessly

of INDUSTRY



across a hardwood desk top, to test the wearing qualities of the non-skid material, and its effect on the finish of a desk. Still another slams 200 pounds of metal onto the seat of a telephone booth, until the screws are loosened which attach it to the wall, or until something else gives way. And always, with all of these tests, the weakest part is made stronger.

Samples of wood used for poles are treated with various preservatives, then placed in glass jars where they are exposed to termites, fungus, various types of rot. Insulators and other outdoor fit-

At upper left, Westinghouse engineer stretches copper bars by loading on weights; below, hydraulic machine at Bureau of Standards puts 2,300,000 pounds compression on girder. Upper right, fadometer tests durability of auto enamel in "sunshine" of carbon arc. Bottom, movie camera records slip lines formed by movement of crystals of atoms as steel strip is stretched

Westinghust

£ 1128.

POPULAR MECHANICS

21120



tings stand up under artificial sleet storms and super-tropical heat.

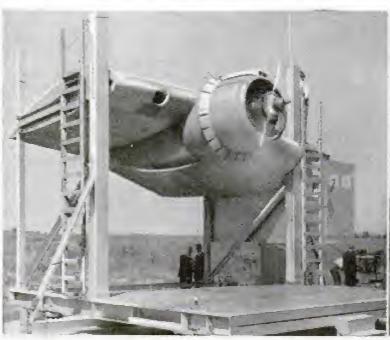
Engineers are always thinking up ingenious ways of making things go to smash; sometimes, of course, things simply refuse to break down. For more than nine years, three fans have been running on the roof of a General Electric company laboratory, exposed to rain and snow and

temperatures all the way from forty below zero to 115 above. Engineers figured that each fan had revolved more than 7,500,-000,000 times; the only breakdown in nine years was a momentary halt when a cable feeding electricity to one of the fans failed.

One manufacturer puts bicycle speedometers on a torture machine that tries to
shake them to pieces, vibrating 1,700 times
per minute. Before any experimental combination of metals is tried out in an airplane it is tried out in a laboratory, where
it must stand up under far greater abuse
than it can ever encounter in the sky. For
example, aluminum alloy sheets destined
for an aircraft factory are bent and twisted
and overloaded until they buckle, while
aeronautical engineers jot down the buckling point shown on dials.

Probably the world's worst weather is in Newark, N. J., and that is no discredit to the eastern seaboard for it's man-made weather, mixed in suitable strengths to test electrical apparatus in a Westinghouse plant. Meters, for example, must operate as precisely at sixty below zero as in tropical climates, and they must keep "ticking" for months in a driving salt mist four times as corrosive as ordinary ocean spray.

There is a special agony in store for the steel blades that are to be pummeled throughout their useful life by steam pressure in turbines. The torture machine pounds the blades incessantly, 600 blows





Breaking strength of belts is determined on machine at top, which has 50,000-pound capacity and also records tensile stress and stretch of belt. Below, left, airplane engine on test rack; right, breaking crockery with impact apparatus in the search for more durable tableware

Briese de landard

per minute for 277 hours; if there are any weaklings in the lot, those blades will fall apart. But properly designed turbine blades of tough steel will survive 10,000,000 beatings with more than a ton of force behind each blow. Another test for turbine steel is the ordeal of the electric furnace. Sample rods of various steel alloys have been kept as long as ten years in furnaces at 1,200-degree temperatures and measured for "creep" as minute as one-millionth of

an inch per inch of length. These rods are subjected to a lever pull as high as 60,000 pounds per square inch and finally deliberately broken to discover the ultimate strength of the various alloys.

In a tractor factory, a half-inch sample bar of steel is pulled apart by a 100-ton hydraulic machine as



Structural properties of walls developed for low-cost housing are determined by subjecting them to racking loads at Bureau of Standards (top). In circle, compressed air is forced into sealed cabin of Boeing "Stratoliner" for high-altitude test in factory. Bottom, left, models for future automobile designs are tested in wind tunnel at Chrysler engineering laboratory; right, a stock car on one those back-breaking runs that show up any weak spot in the automobile

"G-Men's" Giant Enlarger Weighs over a Ton



Huge enlarger in photographic laboratory of Bureau of Investigation in Department of Justice

Huderal Buen

Specially built for the sort of precision work a crime laboratory demands, the giant photographic enlarger in the "G-men's" headquarters at Washington can work with negatives ranging in size from thirty-five-millimeter miniatures to eleven-by-fourteen inch films. One of the largest vertical enlargers ever built, it weighs more than a ton, yet is so delicately balanced that the camera can be adjusted by a slight finger pressure. The Bureau of Investigation of the Department of Justice required a highly specialized instrument for crime detection work and preparation of evidence. Lenses of various focal lengths

can be installed to obtain any magnification desired. Two square mercury-vapor tubes, one fitted inside the other, provide fast and even light, cool enough to obviate any danger of warping the negatives. The outer tubes have twelve-inch sides. The enlarger is thirteen feet six inches overall in height, and its camera is mounted on a frame supported by four-inch steel tubes.

Spring "Claws" in Tire Tread Grip Icy Road Surface

Spiral spring "claws" that grip and dig into the surface of icy roads are molded into the treads of a new skid-resistant automobile tire. There is one endless, corrugated spring to each rider strip, running entirely around the tire. The principle is that as the rubber expands under the load, the spring points are thrust out of the tread to dig into the road surface. The tire is constructed so that there are scores of these claws gripping the road at all times. The tires with the built-in claws are said to give ice traction for about ten thousand miles, after which the owner may use the balance of the tread for ordinary driving. There is no objectionable noise when the tire is used on paved surfaces and the car may be driven at the usual speeds. Tests indicate that the tire may solve one of the major problems of winter driving, since it enables the driver to maneuver, in apparent safety, over ice-covered roads.



Corrugated spiral wire in foreground is imbedded in tread of tire to grip ice when car tends to skid

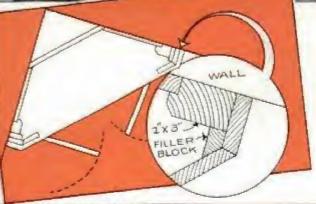
Enterrasmonut



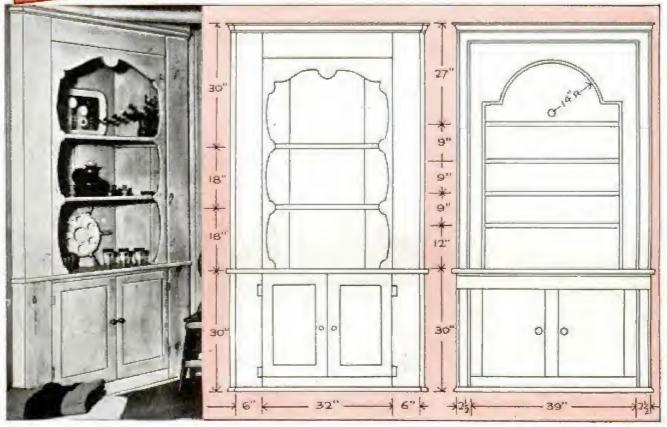


WHILE separate, removable cabinets are generally desirable for those who rent houses and apartments, permanent built-in cabinets are easier and cheaper to build by the home owner. The two adjacent walls in a corner provide sides for the cabinet and many of the frame pieces and shelf cleats can be attached directly to the wall. Either screws or nails can be used for attachment but they should be located so that they can be driven through the plaster and into the studs underneath. Although screws can be driven into lath under plaster where much holding strength is not required, the driving of nails at right angles through plaster and into the lath, frequently causes damage to the wall. Before





driving a screw through plaster, drill a hole to take the screw, which will prevent the plaster from chipping off. It's easy to locate studs, which are usually spaced 16 in. on centers, by lightly tapping the wall with a hammer; a hollow sound indicates space underneath, but a "solid" sound with a slightly higher pitch means that you are tapping over a stud.



Jurned LAMP BASE of "sandwiched" woods

For sheer beauty in contrasting woods, there is nothing like a turned lamp base made of selected blocks of cabinet woods glued up and turned to expose portions of the various woods in the finished work. When gluing up the blank to be turned, the joints must be made perfectly and the blocks of each kind of wood must be exactly the same size and in the same positions on all four sides. The center or core block of the blank has a hole through the center to take a lampcord. Use good glue and mix it according to directions. Keep the blank clamped together tightly until the glue dries thoroughly. For a finish, a lathe polish applied with a cloth is best, although a French polish or a rubbedvarnish finish will show up well on this type of work 15 9/16 DIAMETERS MAPLE 3/6 X 1/4 GREENHEART 36×14 VERMILLION - MAHOGANY WALNUT BIRD'S-EYE MAPLE HOLE (1) HOLLY MAHOGANY STRIPED WALNUT DIA'S. CHERRY

Solvent to Remove Photographs Applied with Oilcan



When removing a photograph that has been attached to a sheet of art work with rubber cement, use a clean oilcan to apply the solvent, such as benzine. With the can, you can apply the solvent to the cement without waste as the photograph is peeled off slowly.

Siding Boards Scraped on Bottom with Bent Putty Knife

When removing paint from a house with a blowtorch, bend a putty knife as indicated and you can scrape the bottom edge of



a siding board and part of the surface of the one under it in one operation. Be sure that the portion of the knife that is bent over is at the same angle as the lower edge of the siding so that the knife will scrape cleanly.—Frank Meyers, Toledo, Ohio.

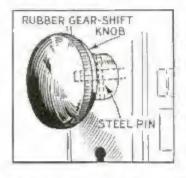
Moth Balls in the Garbage Can Help to Keep Flies Away

One home owner hangs a wire strainer full of moth balls (about ½ lb.) in the lid of the garbage can to keep out flies and other insects. A wire was soldered across the lid of



the strainer to engage a hook soldered to the lid. However, instead of using a strainer, an ordinary mesh bag will serve.

Rubber Doorknob Protects Walls



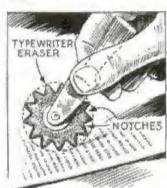
If a door opens so that the knob is likely to strike a wall, sink or refrigerator, damage to these can be avoided by substituting a rubber gear-shift knob for the regular

knob. It may be necessary to use a steel pin to keep the knob on the lock shaft.

-John M. Avery, Dexter, N. Y.

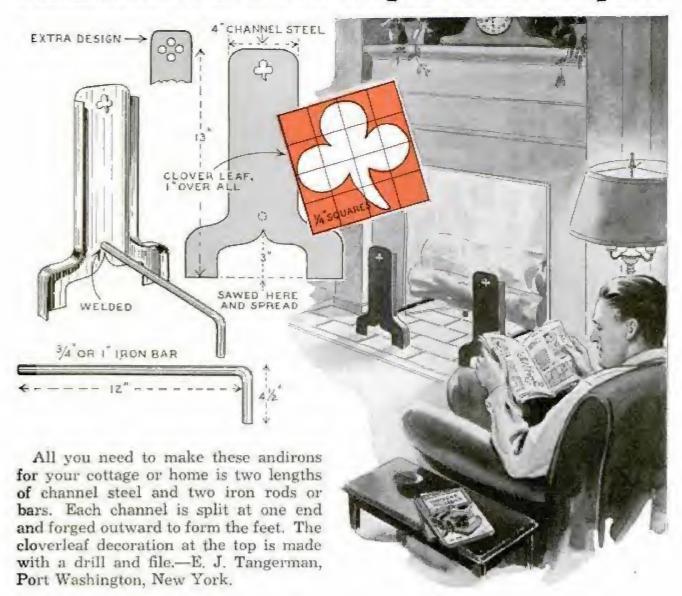
Improving the Typewriter Eraser

The difficulty of erasing single letters or characters with a roller-type eraser may be overcome by notching the rubber to provide a series of points. To prevent the wheel from turn-

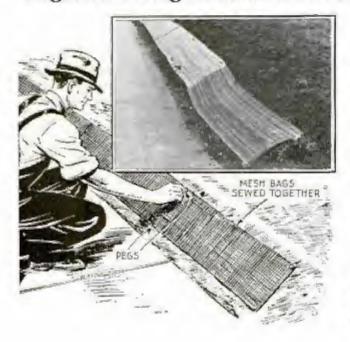


ing when in use, a rubber band is slipped over the metal part of the eraser to engage the rubber teeth of the wheel.

Homemade Andirons Improve the Fireplace



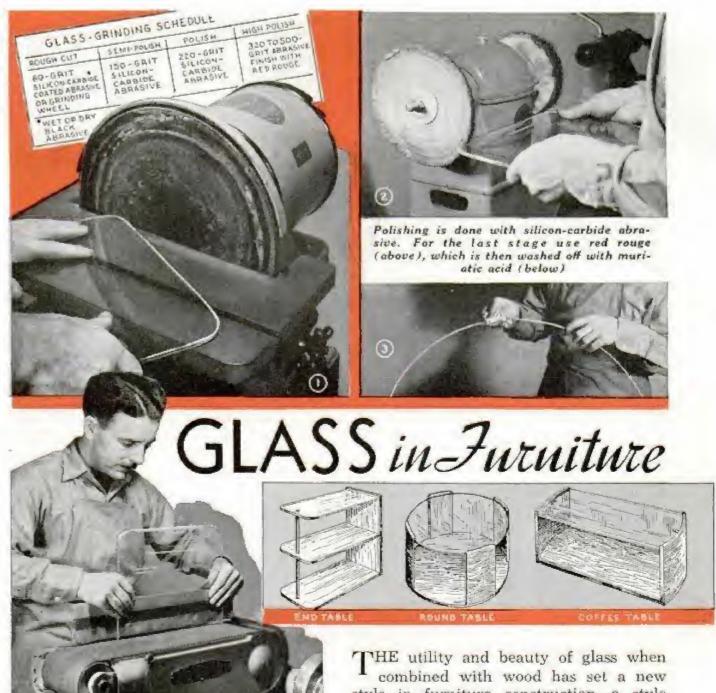
Vegetable Bags Prevent Erosion of Newly Seeded Terraces



Vegetable mesh bags are better than cheesecloth to prevent erosion of newly seeded terraces because the larger mesh of the sacks permits plenty of air and sunlight to pass through the cloth and allows more space for the growing grass. Also, the bags can be left on the ground permanently as they will not be visible after the grass grows, and they will rot away in time. The bags are opened at the seams and sewed together so that only one layer of cloth covers the ground.

—Dale R. Van Horn, Lincoln, Nebr.

¶Many hard seeds such as cannas, sweet peas and morning-glories will germinate quicker if they are nicked slightly with a knife and soaked over night in warm water.



Glass edges can be ground smooth on common shop equipment. Below, running in a border with a small silicon-carbide wheel mounted in the drill-press chuck

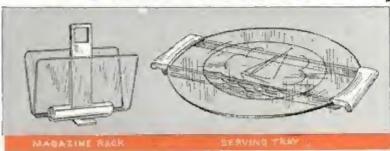


THE utility and beauty of glass when combined with wood has set a new style in furniture construction—a style well within the scope of the average home workshop. Glass is not difficult to work. Contrary to the common viewpoint, it can be shaped and polished as easily as plastics or soft metal, and this with ordinary equipment and materials.

As cut with a glass cutter, glass presents a raw sharp edge. The polishing of this edge is necessary in using it in furniture construction. The abrasive used is silicon carbide, familiar to most craftsmen under one or more trade names—the black variety used for wet or dry sanding. Following the schedule given at the top of this page, glass edges can be brought to any degree of polish. The work can be done on the disk sander, Fig. 1, or on the belt sand-







er, Fig. 4. The glass should be treated like a piece of tempered steel, grinding it dry but allowing the work to cool between bites. For a high polish, the final operation is done with red rouge mixed with water and applied to a felt or stitched canvas buffing wheel, as shown in Fig. 2. Any traces of rouge left on the glass can be removed with muriatic acid, Fig. 3, using rubber gloves to protect your hands. For average work, rouge is not required as a very good edge can be obtained with 220 to 320-grit abrasive.

Small silicon-carbide grinding wheels can be used to advantage in the treatment of edges and also in cutting designs on the glass. Fig. 5 shows a border being run on a disk, using a grinding wheel mounted in the drill press. These small wheels, available in a wide variety of shapes, are con-

venient to produce any design on the surface of the glass. Figs. 6, 7, and 8 show typical examples of such work. The tool used is a small hand grinder. The high speed of these grinders combined with the small size of the grinding wheels makes the cutting as simple as drawing with a pencil. The illustrations show the work in an upright position, but in actual practice the glass is placed over a penciled sketch of the design. The panel in Fig. 6 is sandblasted on the opposite side. The design itself also can be cut by sandblasting. In this method of working, a sheet of tough brown paper is fastened with rubber ce-

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423



ment to the glass. Then the design is cut with a stencil knife, exposing the portions which are to be blasted. Sandblasting is done by any monument works at a nominal cost.

Two simple methods are commonly employed in fastening glass to wood. The simplest of these, as shown in Fig. 9, is a housed construction in which the glass edge is set in a groove. A strip of cloth glued to the glass provides good adhesion. With or without the groove, chromium angles provide a neat and positive method of assembly, as shown in Figs. 10, 11 and 12. Rubber tubing should be used over all screws. Plastic or metal rosettes, turned to shape and threaded, make a neat and solid job, as shown in Fig. 12.

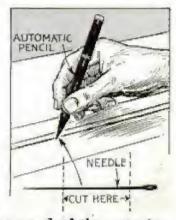
Holes for fastenings are drilled with a steel or hard brass tube, the working end of which has been slotted with one saw cut, as shown in Fig. 14. A solid rod can be used for small holes. Good handwork can be done with a three-cornered file. Holes can be countersunk for fastenings with the use of a cast-iron rod turned to an 82-degree point, as shown in Fig. 14. The cutting is done with 80-grit silicon-carbide grains. These are mixed with water to form a paste. For accuracy it is best to use a drill press, as in Fig. 13. Cutting can be done also by means of turpentine mixed with a small amount of camphor. This can be used in grinding designs or polishing edges.

A word about the glass itself. The most

used variety is ¼-in. polished plate glass, available in crystal, blue and pink. The colored glasses make up very nicely. Good plate glass can be obtained cheaply from auto wrecking firms. For ordinary work, heavy sheet glass, ¼ in. thick, is somewhat cheaper than plate glass. Safety (non-shattering) glass is worth-while protection at slight extra cost. Special tempered plate glass should be used where the work is to be subjected to great heat (fire screens) or where additional strength is required. Plate glass, ¾ and ½ in. thick, is effective for table tops and shelving.

Automatic Pencil Used as Awl

An automatic pencil of the propel-repel type provides a handy pocket scratch awl when a scriber point is substituted for the lead. A scriber for the pencil can be made from a needle by breaking off both



ends and pointing one end of the remainder. The needle, of course, must be of about the same size as the lead used in the pencil.—Burl Knutson, Bismarck, N. D.

Newspapers rolled as tightly as possible and tied into knots provide good kindling.

"BEEHIVE" JEWELRY BOX



Crutch-Like Rests on Wheel Chair Aid Patient While Arising



Patients who have to use wheel chairs and experience difficulty arising from them will find armrests of the type shown helpful. The rests, which are made like the top of a crutch, fit in holes drilled through the chair arms. The distance that the rests must extend above the arms will have to be found by experiment.

Wood Dowel Guides Drill Point When Reaming Out Threads



When drilling out the threads of a tapped hole in metal, I find that a hardwood dowel of approximately the same size as the hole, driven or turned into it, makes an excellent retarder for

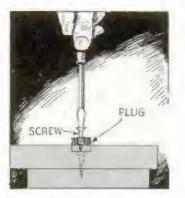
the drill, to prevent "digging" and to assure against breakage. The top of the dowel should lie in a little below the surface of the metal in order that the drill will center just before it contacts the wood.

When drilling out threads in a hole that goes through the work use a stop piece, held by C-clamps as shown.

-W. C. Wilhite, Carlinville, Ill.

Countersunk-Hole Plug Removed Easily with Screw

Wooden plugs that have been glued over countersunk screw heads to hide them are easy to remove with another screw. Just drive it into the center of the plug. When the end of



the screw touches the head of the countersunk one, the plug will rise as the screw is turned.

—Herbert L. Arrall, Newburyport, Mass.

Belt Dressing Cements Abrasive to Sanding Block



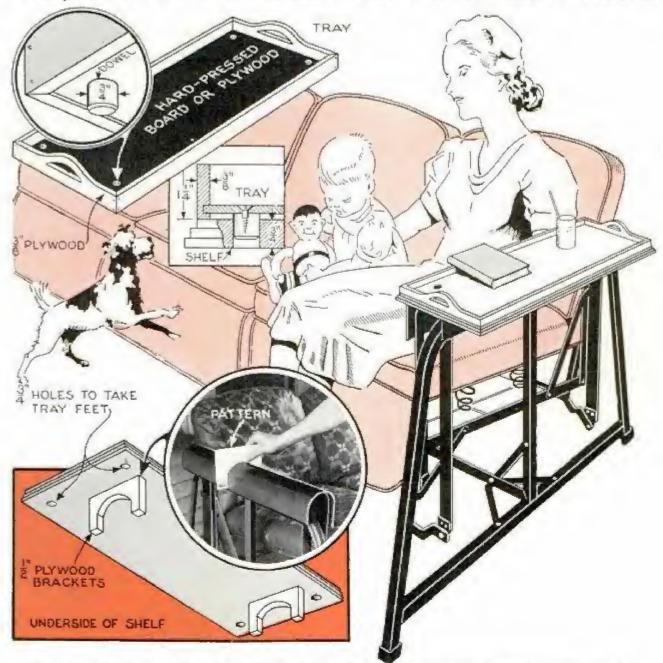
Next time you are obliged to use a scrap piece of wood as a sanding block, rub the under surface with a stick of belt dressing. This will cause the sandpaper to adhere to the block and will prevent slipping.

Steel Wool in Shotgun Shell Is a Good Polisher

Stuffed tightly with fine steel wool, an empty shotgun shell that has been fired provides a good polisher for metal. The paper of the shell wears away with the wool so that the latter is always exposed.



Tray on Porch Glider Serves as End Table

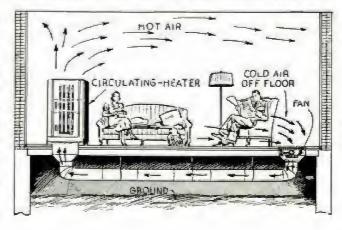


Slipped on the rounded, sheet-metal arm of a porch glider, this removable utility tray takes the place of an end table. U-shaped brackets are attached to the bottom of the shelf which supports the tray. Short dowels screwed to the bottom of the tray register in corresponding holes in the shelf

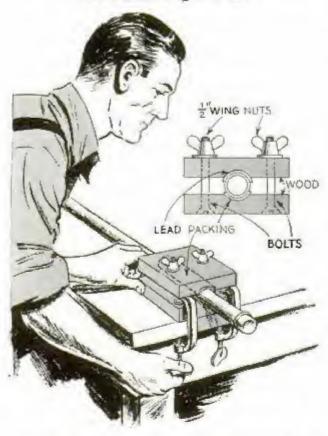
Cold Drafts to Heater Minimized by Air Duct under Floor

Where a circulating heater is used in a room and cold drafts moving over the floor toward the heater are objectionable, they can be eliminated to a large extent by installing an air duct under the floor, registers being provided at both ends as shown. The steady flow of air in the duct can be accelerated by using a fan placed in the duct or just under one of the registers. It should be the type having thrust bearings if it is installed in the manner shown.

-George Sirn, Macedonia, Ohio.

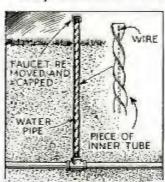


Lead-Lined Clamping Blocks Serve as Pipe Vise



If a regular pipe vise is not at hand, one can be improvised from two wood blocks and two strips of lead. The blocks are roughly grooved to suit the diameter of the pipe, and drilled for two clamping bolts. In use, one block is fastened to a bench with C-clamps after which the other one is clamped over the pipe with the lead strips next to the pipe. This presses the soft metal into the rough surface of the pipe and prevents it from turning.—C. A. Oldroyd, Barrow-in-Furness, Lancs., Eng.

Hydrant Protected in Winter

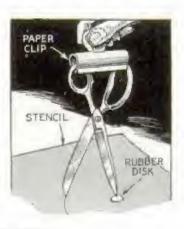


During the winter months exposed water pipes that are not convenient to drain, such as lawn hydrants, may be prevented from bursting by the following method: Cut a long strip of

rubber about 1 in. wide from an old inner tube. Wind this spirally around a piece of No. 9 wire long enough to reach below the frost line. Remove the faucet, insert this in the pipe and cap it. The rubber will compress enough to prevent the pipe from bursting when the water freezes.

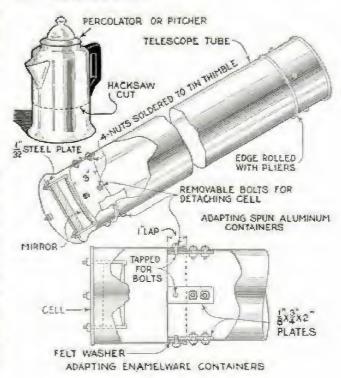
Pair of Scissors to Cut Circles on Mimeograph Stencil

To trace circles on a mimeograph stencil, a compass may be constructed from a pair of scissors and a paper clamp. To avoid perforating the stencil at the center, place a small rubber disk under this point of the scissors.

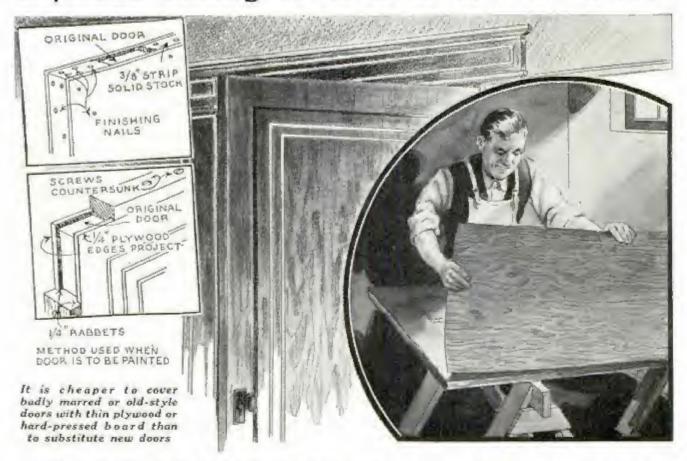


Telescope Cells and End Trim from Cooking Utensils

One of the most important points in securing a finished appearance in a telescope tube is to have a good-looking cell and end trim. Good cells for this purpose can be made inexpensively from cast and spun-aluminum cooking utensils. While the drawing shows how a cell can be made from a pitcher or percolator, the various shapes of other utensils will suggest many novel adaptations.



Plywood Facing Saves Cost of New Doors

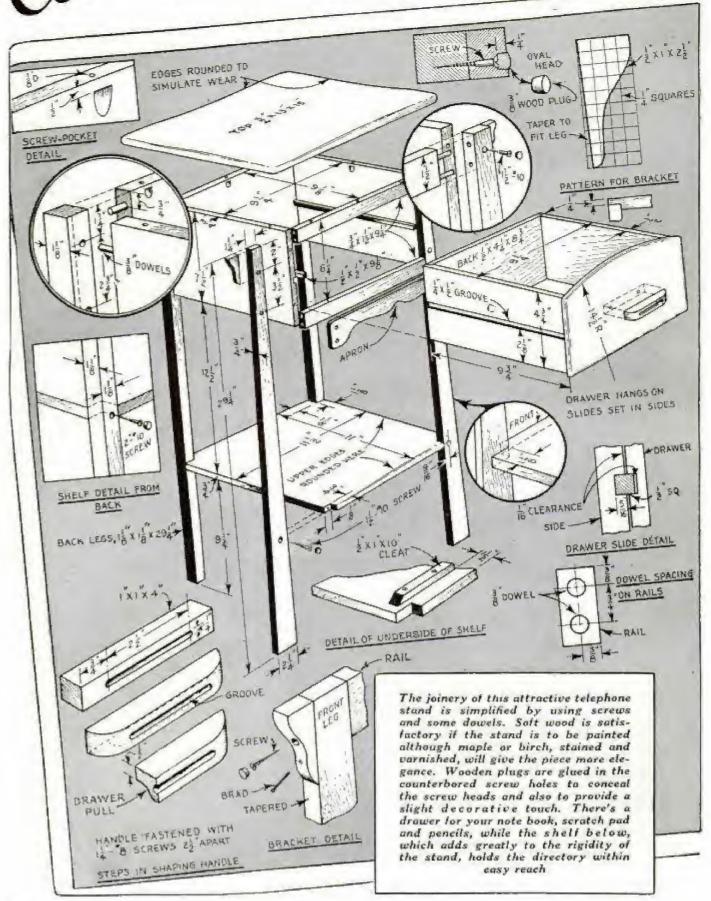


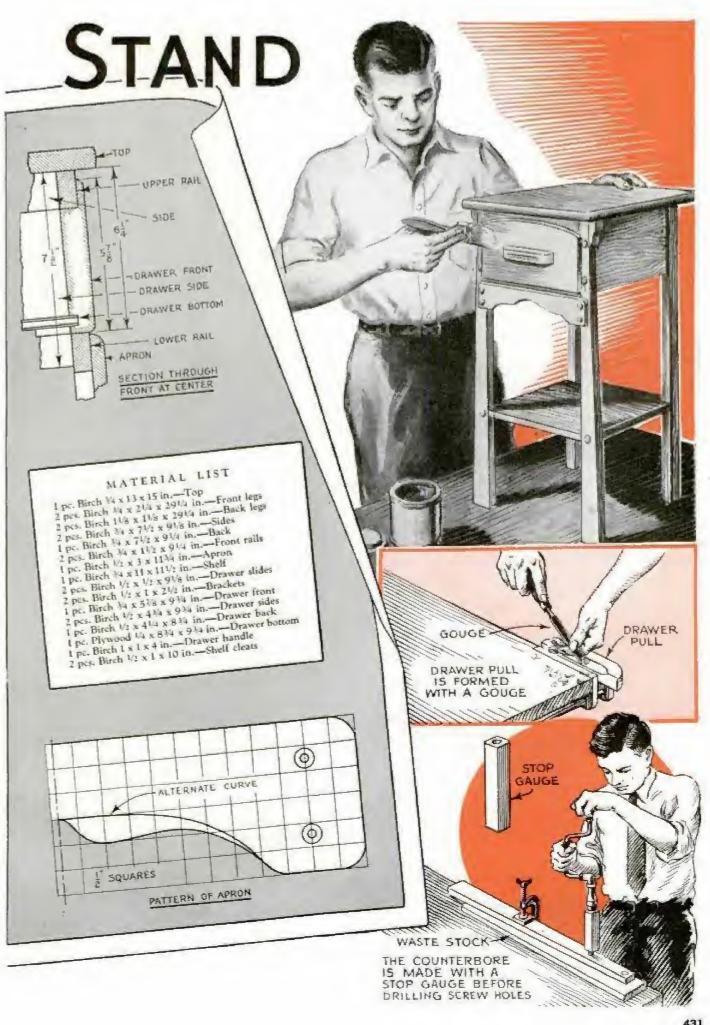
Instead of replacing old interior doors when they are badly scarred or are so far out of date that they will not harmonize with a modernized room, you can avoid this unnecessary expense by simply covering the old ones with 4-in, plywood or with hard-pressed board. In some cases the covering may be glued to the door, if the varnish or paint is entirely removed so that the glue will adhere. The covering also can be fastened in place with finishing nails or flat-head screws, nail holes and screw heads being filled if the surface is to be painted later. The simplest way to apply the covering is to cut it slightly larger than the door, after which you carefully saw off the excess and smooth down the edges to be flush with the edges of the door. However, if the door edges are rounded, which would leave a groove between the door and the covering, or if the edges are badly marred, it will be necessary to use facing strips. For application of strips remove the door and rip % in, off the edges of the door. Then rip %-in, stock to a width slightly more than the thickness of the door and attach with glue and finishing nails or screws. Miter the strips at the corners. Plane the strips flush with the door on both sides. Cut the covering slightly oversize, spread glue on the edges of the facing strips and covering, after which screws are used to fasten the latter down securely, the heads of the screws being countersunk below the surface. When the glue is dry, plane the covering edges flush and round the corners slightly with fine sandpaper. In re-hanging the door you will have to reset the hinges, lock striker plate and the stops to take care of the added thickness. The new surface may be finished to suit. Striping done carefully will relieve the flat appearance if this is objectionable.

Improving Furnace Water Pan

If you heat your home with a warm-air furnace, and humidity is too low, you can increase evaporation of water in the furnace pan by hanging strips of old towels in it. One end of each strip should be in the water and the other should hang over the side of the pan. The number of strips necessary will have to be determined by experiment.

Cottage TELEPHONE





Painted Beehive Covers Reflect or Absorb Sun's Rays



Taking advantage of the reflective and absorbent powers of different colors of paint, a bee keeper made the covers of his beehives reversible, painting one side black and the other side aluminum. In the early spring, the boards are turned with the black side out to absorb all possible heat from the sun and stimulate brood rearing to build up the strength of the colonies. Later, during the hot weather, the boards are reversed, aluminum side up, to reflect the heat and keep the interiors cool.

Drop Leaf under High-Chair Tray Prevents Child Standing Up

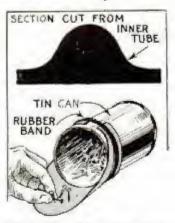


To prevent a small child from standing up in its high chair, hinge a drop leaf to the underside of the tray. When down, the leaf leaves so little room between chair and tray that it is impossible for the child to withdraw

its legs from a sitting position. When not in use, the leaf may be raised and held against the tray with a turn button.

Rubber Lip on Nail Container Makes Selection Easy

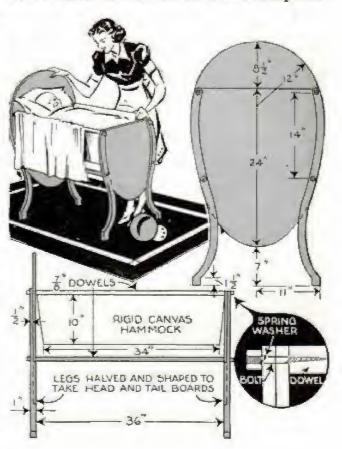
Rubber lips cut from old inner tubes and attached with rubber bands to tin cans containing nails, screws and other small parts make it easy to select a desired part. Just tip the can over so that the contents



roll out on the lip. After the selection has been made, tip the can back and the contents slip into it.

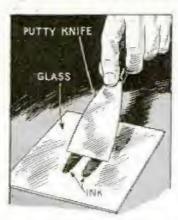
Child's Crib of Unusual Design Has Hammock Bed

Originated in England, this child's crib is unusual in appearance, and can be made inexpensively as it consists merely of two ends spaced apart by four heavy dowels, from which the hammock bed is suspend-



ed. This is made of canvas, which is hemmed at the ends to slip over the two upper dowels. The hammock lining extends down over the sides in form of valances to hide the dowels and canvas. It is best to make the hammock semi-rigid by sewing a couple of hems in each side to take strips of thin plywood. The legs are cut from solid wood and the end panels are plywood. Notice that the inner surfaces of the legs are cut away or halved to take the panels.—N. S. Candy, Southampton, Eng.

Simple Method of Matching Paint or Printing Ink

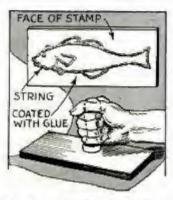


On jobs of printing or painting
where certain colors must be blended accurately to
match a color already in use, try a
piece of glass as a
matching surface
on which to compare the various
colors. Put small

amounts of the colors on the glass and spread them with a putty knife. Apply pressure as equally as possible in spreading the colors and you will be able to tell at a glance those that match.

Stamp Aids in Stenciling

This stamp will prove useful for those who wish to paint a design around a ceiling, cut a number of duplicate wood figures or decorate cloth and paper. A wood block slightly larger than the



design to be stenciled, is coated with glue or varnish, after which a heavy string or light cord is laid on the tacky surface to form the design. The finished stamp may be inked with a pad, roller or brush, as the ink will not adhere to the glue-covered surface of the block.

-Paul A. Ruddell, Washington, D. C.

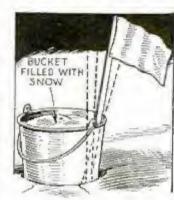
Metal Guide to Saw Straight Through Thick Work



Difficulty some workmen experience in sawing straight through a thick plank can be avoided by using this simple guide. It is shaped from flat iron and is held on the work with one hand while the other hand operates the saw.

Keeping Holes Through Ice Open for Fisherman

During moderately cold weather, holes chopped in ice for fishing may be kept from freezing over at night by placing snow-filled pails in them. As a further precaution against freezing,



one fisherman inserts a lath in each pail and ties a cloth to it. The cloth serves as a marker, and the slightest breeze causes the pail to rock back and forth, which helps prevent ice forming.

Crayon marks may be removed from wallpaper by covering the soiled surface with a paste made of fuller's earth and carbon tetrachloride; allow it to dry and remove by brushing.

Experiments with a VEST-



Two flashlight dry cells, a pocket voltmeter or ammeter, a milli-voltmeter, an electroscope, neon tube, two coils of wire, a pair of magnets, a small compass and five vials containing sulphuric acid, copper-sulphate solution, toluene, bromide water and ammonia. Also a small tunnel, pieces of sealing wax, silk and a couple of test tubes

FITTING in a box no larger than a postcard size camera, this miniature laboratory, which can be assembled for a few dollars, will serve to demonstrate many electrical, chemical and physical phenomena for entertainment and instructive experimentation. Contents of the kit are listed under the photo at the left.

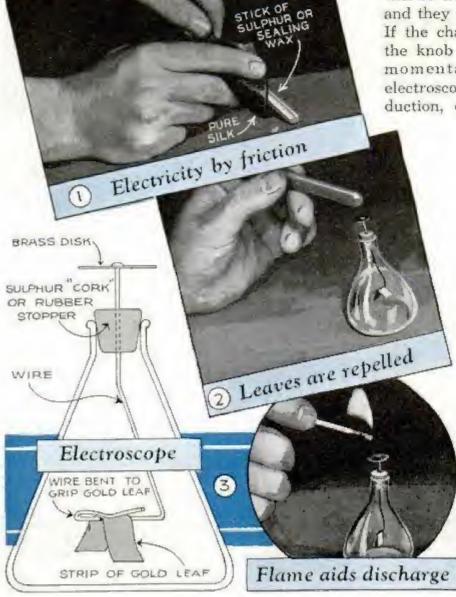
Using an Electroscope: A sealing wax

or sulphur rod becomes electrified when rubbed briskly with a dry piece of silk as in Fig. 1. The charged rod then can be used to charge an electroscope, Fig. 2, which can be made from a small flask or old bottle and a piece of gold leaf, Fig. 3.

By touching the charged rod to the knob of the electroscope, the leaves will be charged the same as the rod, and they will then repel each other. If the charged rod is held close to the knob and the latter is touched momentarily with the finger, the electroscope will be charged by induction, oppositely to the sealing-

wax rod. Then the leaves will repel each other as soon as the rod is taken away, but not when it is brought close. Other nonconductors such as glass rod, hard rubber, wool and fur can be used. In some cases the non-conductor will be charged oppositely to a wax rod rubbed with silk.

How Electric Generators Work: An electric current is generated when a magnetic field is cut by a wire. A coil of 1,000 turns of No. 34 insulated magnet wire is connected to a smaller coil of 1,500 turns of No. 38 wire. A small compass is placed over the latter coil, and a powerful permanent magnet is moved over the larger



POCKET "LAB coil as in Fig. 4, at which instant the compass needle will be deflected slightly, indicating generation of current. If the compass is placed on a coil of wire connected to a battery of two dry cells, as in Fig. 5, the needle will be deflected. This shows that the passage of an electric current

through a conductor produces a magnetic field. The compass needle deflects only

when the circuit is closed or opened. How a Transformer Works: The principle of a transformer is illustrated in Fig. 6. The 1,000-turn coil is connected to a 110volt a.c. line, and the 1,500-turn coil to the small neon tube, which will light, although it is not directly connected to the current from the battery. If an iron core is slipped through the two coils, the efficiency will

be improved greatly.

Electroplating Demonstrated: How electroplating is accomplished is illustrated in Fig. 7. Two dry cells are connected as shown. The negative line goes to a strip of brass or iron, and the positive to a strip of clean copper. The two strips are immersed in a solution of copper sulphate in

a test tube so that they will not touch each other. They can be kept apart by little pieces of cork. The brass or iron strip will become covered with a red deposit of copper.

Electricity Decomposes Water: Electrolysis, or decompo-



TO HO W. A.C.

ARGE COIL

How transformers work

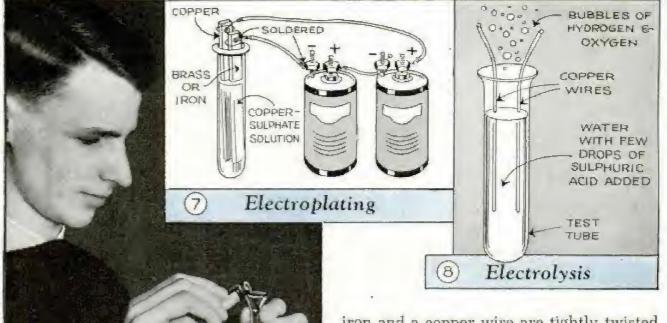
sition by electricity, of water into hydrogen and oxygen is shown in Fig. 8. Copper wires attached to the terminals of a two-cell battery are immersed in a test tube full of water to which a few drops of sulphuric acid have been added to

COMPASS

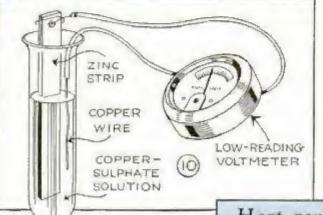
make it conductive. Do not get the acid on hands or clothes as it will cause burns. Should you spill some of the acid, wash with water in which a copious amount of ordinary baking soda has been dissolved. Or use ammonia. At the negative wire, bubbles of hydrogen will be released, and

MAGNET

LARGE COLL 1000 TURNS NO.34 INSULATED WIRE



(9) Simple electric cell

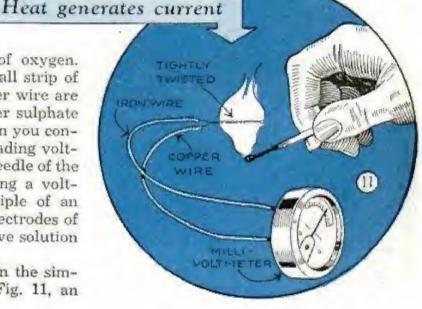


iron and a copper wire are tightly twisted together at one end, and the opposite ends are connected to the millivoltmeter. If the twisted junction is heated, a voltage will be produced, as indicated by the meter. This demonstrates the operation of a thermocouple.

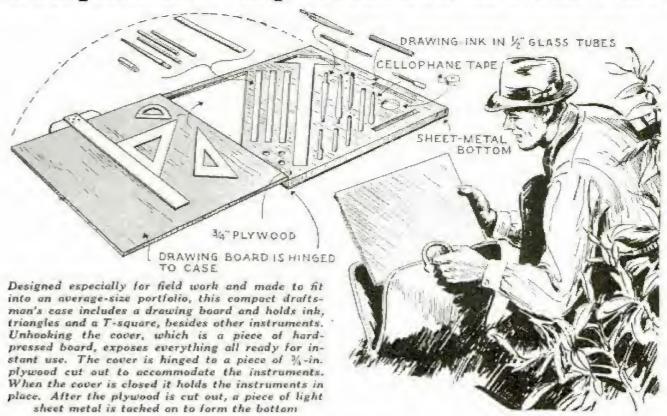
Photo-Chemical Reactions: Many chemical reactions are induced or accelerated by the action of light. If a small amount of toluene and a few drops of bromine water are placed in a test tube, no reaction will occur as long as the mixture remains in the dark. However, when exposed to light, a reaction will take place, as evidenced by a change in color. The role of light energy in chemical change is important in photography and particularly in nature as witness the variegated colors of vegetation.

Simple Electric Cell: If a small strip of zinc and a short length of copper wire are immersed in a solution of copper sulphate a current will be registered when you connect the two metals to a low-reading voltmeter as in Figs. 9 and 10. The needle of the voltmeter will deflect, registering a voltage. This illustrates the principle of an electric cell consisting of two electrodes of different metals, and a conductive solution in which they are immersed.

Heat Generates Electricity: In the simple experiment illustrated in Fig. 11, an



Complete Drawing Outfit Fits in Brief Case



Midget Acrobat on Toy Windmill Cuts Amusing Capers

Actuating a trapeze performer in a realistic manner, this wind toy will afford you many laughs, especially on a gusty day when the mill runs erratically. First get a base for the assembly, which can be a piece of hardwood or light channel iron. Fasten vertical pieces to it to carry the shaft and pulley that rotate the figure. Then provide simple bearings on the base for the airwheel shaft, which is a length of brass rod. Next make up the wheel hub and pulley from hardwood, and drill it to take the

shaft with a force fit, placing a washer between the hub and shaft bearing to prevent binding. Now you are ready for the wheel, which is a tin disk cut to resemble the wheel on a regular farm windmill. This is tacked to the hub. A tin tail vane is fastened to the rear of the base. Arms and legs of the figure are pivoted loosely to the body, while the arms are clamped tightly to the shaft.

DUMBIY 3" DIA CLAMP IDLER FOR DRIVE DUMMY BELT HUB AND PULLEY LOCK STAPLE TAIL VANE, IN AIR WHEEL BEND WASH-LINE POST The acrobat swings on a rod turned by belt connected to the shaft of the air wheel

(Ammonia and water will often remove red-ink stains from white cloth.

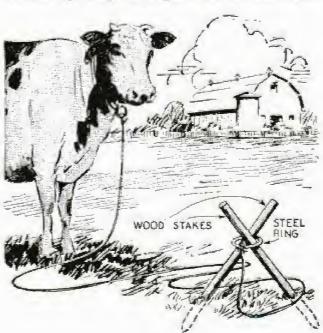
Typewriter Skirt Keeps Pencils from Rolling under It



If you are annoyed by having pencils roll under your typewriter, a wide rubber band placed around the feet of the machine will prevent this trouble. A section cut from a large inner tube will be just the thing for the purpose.

Tangling of Tether Avoided by Double Stakes

Two stakes, driven into the ground at the angles shown, will keep a tether from becoming tangled, regardless of the num-



ber of times the animal circles the anchorage. The tether should be made fast to the stakes by a loose loop or a large ring.

Safety-Razor Guard Used as Rack for Microscope Slides

A guard or comb from a doubleedged safety razor is a convenient holder for microscope slides. The slides fit between the prongs, which can be bent slightly to hold them firmly. With the



slides placed in order, they will collect fewer fingerprint or dust smudges than if they were put in a box or laid flat on a table.

Paintbrush Wrapped in Paper to Prevent Drying Out

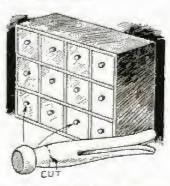


One good method of preserving
paintbrushes is to
wrap them in paper and soak this
with linseed oil.
Wrap the paper on
the brush to a
thickness of 1 in.,
letting it extend
well above the
ferrule. This pro-

vides a well into which the oil can be poured to saturate the paper.

Clothespin Heads Provide Pulls on Small Drawers

In fitting his shop with a small wall cabinet for storing screws, nails, etc., one craftsman quickly provided neat, little knobs for the drawers by cutting the heads off



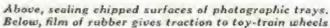
of clothespins. Screws through the drawer fronts from inside attached the knobs.

What You Can Do With, TIRE "PAINT"

White or black auto-tire paint, which consists of liquid rubber with a pigment, has many uses. Besides those pictured below, it may be used to prevent slipping and marring, as on the bottoms of ash trays and similar articles, and to whiten or darken the surface of any rubber article. It may be applied with a brush or air gun, and dries to an elastic surface that will withstand wear, creasing and weathering. One coat is sufficient over a non-porous surface of similar color. Use two coats when white is applied over black, or when the surface is porous as in the case of wood or leather

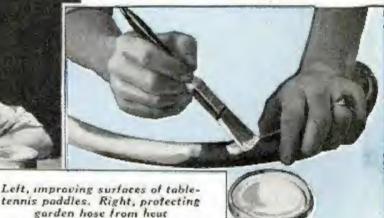


An application of tire paint on the underside of throw rugs will keep them from slipping on polished floors





Closely woven cloth may be waterproofed with one coat, while several coats may be applied to make rubberized sheeting



Broom Slipped Inside Sack When Sweeping Snow



If you use a broom to sweep paths through light snow, slip a sack over the straws and fasten it in place with a rubber band. The sack not only will aid in effecting a clean sweep of the snow, but will protect the broom from damage and wear.

Metal Tape Ornaments Lamps

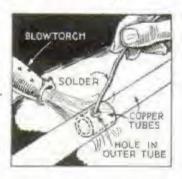
After turning a wood standard for a table or bridge lamp, it may be given an attractive metal finish by winding it with a strip of zinc tape of the kind sold for



binding linoleum seams. Apply the tape in a spiral, first coating the wood with shellac to hold the tape in place.

Simple Method of Soldering Joints on Telescoped Tubing

When soldering two pieces of tubing together, where one fits tightly inside the other, the difficulty of flowing solder into the joint can be overcome by drilling a small



hole in the outer tube. Flux and solder can be fed into the hole to form a perfectly soldered joint. This method can be applied to other jobs where it is difficult to "tin" the work before soldering.

-Roy S. MacNeill, Shelley, B. C., Can.

Metal Shield over Mousetrap Safeguards Poultry



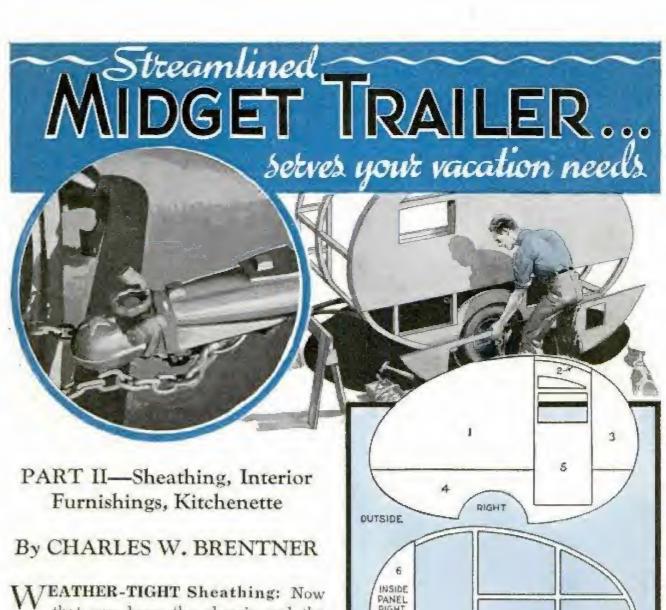
Scrap ends of eaves trough, which may be obtained for practically nothing at almost any hardware store or tin

shop, provide good covers for mousetraps that are to be set in a poultry house, or in other places where fowls or household pets might get into them. The open ends of the trough invite the inspection by the little rodents, and the traps are therefore more effective than when set in open places.

Hose Keeps Punch from Sticking

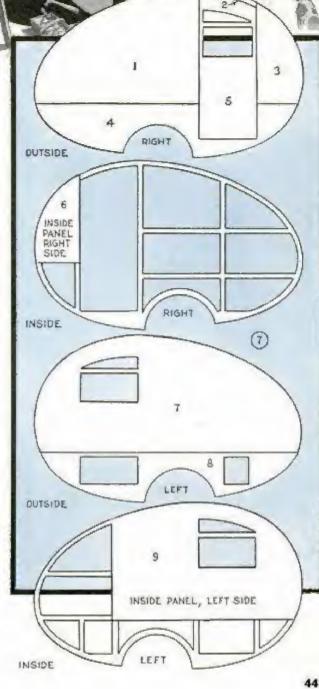
To keep a tapered punch from sticking in wood or metal, drill a hole through a piece of lawn hose and force the punch through it. This will prevent the punch wedging in the hole.





that you have the chassis and the side frames finished, you use the latter as templates in laying out the side panels to size. These are cut from 1/8-in. tempered hard-pressed board. Before you cut the board, note carefully the number and arrangement of the pieces on the right and left sides of the body as in Fig. 7. Five pieces are required for the right side frame on the outside, but only one small piece, No. 6, is needed for the inside. The balance of the exposed frame is covered by a cabinet and clothes closet. Only two panels are required for the exterior of the left side and one large panel for the interior.

An easy way to cut hard-pressed board by hand is to clamp the side frame to the large sheet and cut with a fine-tooth compass saw or with a hacksaw blade, reversing the blade so that the teeth cut on the up stroke. Smooth the edges of the board after sawing with a block plane. This done, you lay the panels aside while you assemble the body frame and the fenders over





UPBOARD WATER SHELF OVER DID 9 40 HAROR IN SIDE BOOR Y ASSIST CAD.

the wheel wells. The latter are finished with semicircular pieces of plywood screwed to the inside of the wheel-well openings and an arch, made of the same material, is built into the side frame on each side over the well. Then the galvanized-iron fender is fastened over this with screws. These parts are shown in place. With the frame assembled and squared up, you're ready to put on the sheathing. This is fastened with ovalhead screws and washers spaced approximately 6 in. apart. Metal-trim moldings finish up this part of the job.

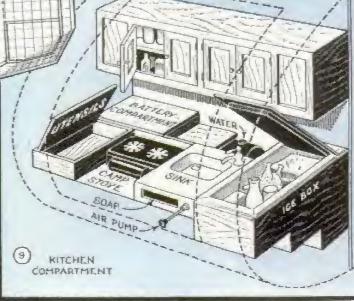
Sleeping Quarters: The two details in Fig. 8 give sizes and locations of the built-in equipment. A standard bed spring and mattress unit is supported by two cross members, but before this is shoved in through the rear (the kitchenette partition is not yet installed) the cabinet and clothes closet on the right or door side are built in, in the positions shown in Fig. 10. A small chemical toilet is built forward, just inside the door. Thin wallboard, supported by suitable framing, is used in the construction of this equipment. The rear

partition, Figs. 8 and 10, is also of

the same material.

Kitchenette: After installing the partition, the kitchenette can be built in the individual's favorite method of cabinet work. In the original, Fig. 9, the units were built separately and then set into the rear compartment, the perspective view showing the general arrangement. When not in use, stove, sink and water-tank compartment are covered with hard-pressed board in tile pattern, making a neat, clean table in appearance.

Icebox Is Cork-Insulated: A large icebox is built into the original trailer, the details being shown



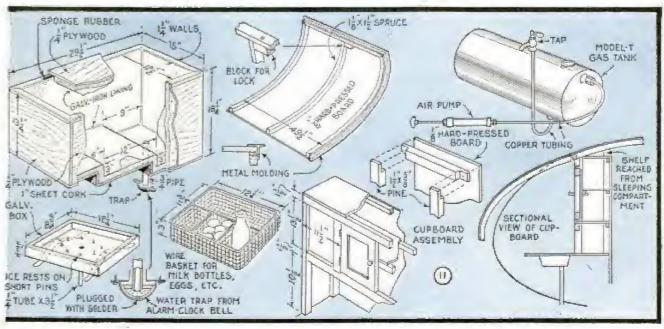
in Fig. 11. As you will see, a stepped-box of plywood is made first and lined with 1-in. sheet cork, then a galvanized sheetmetal lining with corners soldered is made to fit over the cork insulation. Around the edge of the lid is a strip of sponge-rubber weatherstrip to make a tight seal. The drain pipe is fitted with a water-seal or trap made from an alarm-clock bell. This prevents loss of cold air from the box. The ice tray shown is especially adapted for trailer use, being fitted with a pair of stiff spring feet, and with nail ends about 1/2 in. long soldered to the sheet-metal bottom so that the ice melts down upon them and will not slide about. No nails should be used in assembling and fastening either the icebox or the other kitchenette units in place. Use screws instead. They hold better than nails of any size under the conditions of vibration to which these parts are subjected. Not only that, but units fitted into close quarters such as these can

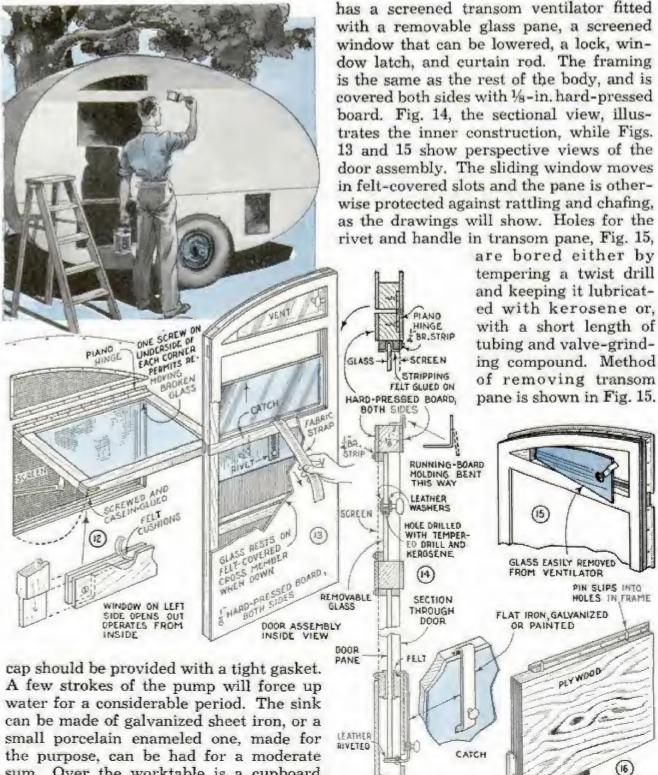
always be removed intact if assembled and fastened with screws of proper size. It's a good idea to anchor the stove and sink securely, otherwise these units might be thrown about loose in the compartment should the trailer be called upon to travel over a rough road or steep

mountain trail.

Water System and Sink: A Model-T Ford gasoline tank is fitted out for an air-pressure water system, Fig. 13. The filler







A few strokes of the pump will force up water for a considerable period. The sink can be made of galvanized sheet iron, or a small porcelain enameled one, made for the purpose, can be had for a moderate sum. Over the worktable is a cupboard made in the conventional manner, as in Fig. 11. Hard-pressed board is used for the paneling, and all framing is ¾ by 1½-in. pine. The top of this cupboard serves as a shelf for the sleeping compartment on the other side of the partition. Construction of the lid for the kitchenette is similar to that of the body, and details are given in Fig. 11. The edges are bound with aluminum running-board molding.

Door Has a Transom: A great deal of convenience is built into the one door. It These panes are cut from plate glass with an ordinary glass cutter, and the edges smoothed with an oilstone. The window on the left side is swung out by a bracket on the inside, working through the screen. The transom vent above this is the same as in the door, and the frame assembled as shown, Fig. 12. Also on the left side are two removable panels, one to give access

METAL MOLDING

PANEL CLOSES

STORAGE SPACE UNDER

BED (LEFT SIDE)



MATERIAL LIST

SHEATHING

1 pc. 4x10 ft. 1/8-in. tempered hardpressed board

pressed board

2 pcs. 4x12 ft. 1/2-in, tempered hard-pressed board

2 pcs. 3x12 ft. 1/2-in, tempered hard-pressed board

5 pcs. 4x6 ft. 1/8 -in. tempered hardpressed board

pcs. 4x12 ft. ½-in. tempered hard-pressed board 1 pc. 4x6 ft. hard board in tile pat-

tern for kitchenette worktable MISCELLANEOUS

4 pcs. windshield glass, sizes in drawings 1 pc. 12 in. x 8 ft. copper screen for windows

bracket for opening left window 12-ft. brass piano hinge, door win-dow, and kitchenette lid

6 cupboard latches, 6 pr. hinges 1 trailer sink, drain for sink, I stove

sq. ft. galv. sheet metal for icebox lining

8 sq. ft. 1-in. sheet cork for icebox lining

Tubing for drain

1 pc. galvanized sheet metal 3x4 ft. for fenders

locks, to door, kitchenette and two side panels

set bed springs and mattress

SCREWS, BOLTS, ETC.

2 U-bolts for tow bar gr. 1¼-in. round head No. 8 screws and 200 washers to fit gr. ¾-in. No. 6 flat-head screws gr. ¾-in. No. 8 R.H. screws and 200 washers to fit

2 gr. 1-in. No. 8 oval-head screws gr. ¼-in. No. 5 screws gr. 1¾-in. No. 8 R.H. screws and

1 gr. washers to fit 1 gr. 1¼-in. F.H. No. 8 screws 1 gr. 1½-in. F.H. No. 8 screws 2 gr. 1/2-in. No. 5 F.H. brass screws

ELECTRICAL

36 ft, insulated wire

2 dome lights for 6-volt current 1 6-v. socket and bulb, kitchenette sockets and bulbs for 110-volt current

1 plug-in socket for 110-volt current

2 plug-in sockets for 6-volt current

two-way switch storage battery

1 tail light, 1 blue clearance light

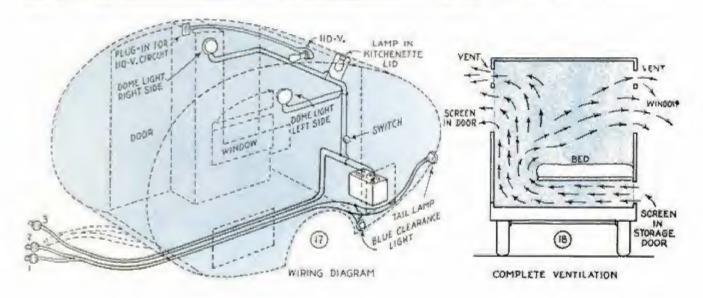
FINISHING

94 ft. aluminum running-board molding

12 ft. 1/4-in. brass strip for over screens

12 ft. half-round molding Paint, spar varnish, casein glue to storage space under the bed, the other to the battery box. Each is fitted with a lock, and with two pins at the top that set in holes bored for the purpose, Fig. 16. The larger panel is taken out in warm weather, in camp, and a screen substituted, giving excellert ventilation as in Fig. 18.

Wiring: Three circuits are installed for lights in the original trailer, Fig. 17. One is a plug-in for 110-volt lines, while the other two are for 6-volt lines from car and from storage battery in the trailer. The wiring can be extended to any point in the trailer for convenience.



Snow Packed under Feet on Skis Is Removed Easily

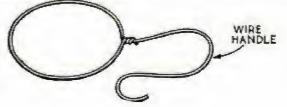


It's no trick to remove snow that packs on skis under your feet if you use a scraper like the one shown. It consists of a wood handle having several thicknesses of screen wire tacked around one end to form a flexible scraping surface. As there are no sharp edges on the scraper to come in contact with the ski there is little danger of damaging the finish.

Slip-On Handles for Beakers

Metal beakers and similar round containers can be made convenient for pouring or for handling when hot by adding





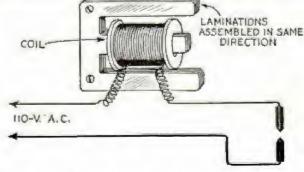
simple wire handles to them. Bend the wire around the beaker and twist the ends together, leaving one long to form the hand grip. The flange at the top of the beaker will keep the handle from slipping off.

-Burl Knutson, Bismarck, N. D.

Old Transformer Used as Coil for Electric-Arc Circuit

If you are going to make an electric-arc soldering outfit or other apparatus requiring a similar reactance or choke coil in the circuit, a transformer from a battery charger can be used as the coil. This will save the tedious work of making one. If the wire of the primary winding of the transformer is too small, it will be necessary to rewind it. The secondary winding





is not used and may be removed. In the normal assembly of the transformer, the laminations are inserted through the winding core alternately, one from one end and the next from the other end. Remove these laminations and insert all of them from the same end. Then attach lead wires to the ends of the coil and connect it in series with the arc feed line. Try out the apparatus with all the laminations in place. Then remove a few of the pieces and try it again, continuing in this manner until the arc operates well without an excessive current flow. An a.c. ammeter in the line while experimenting for the proper core is a handy guide.



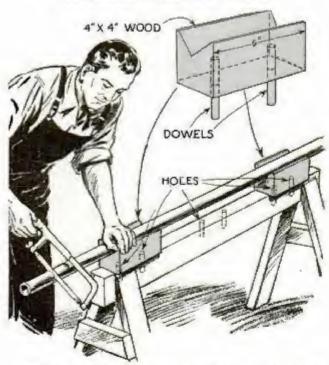
Tooled in much the same manner as leather, printers' mat paper, which is relatively soft and retains impressions, can be used for making novelties such as plaques, key-holder covers, book ends, coverings on boxes, vases, cigarette holders, etc. After moistening the back of the mat paper, it is laid on a flat surface and a design is transferred to it with carbon paper. Then you indent the surface with tools used for leather work, or by means of an orange stick obtainable at any drugstore. The paper retains indentations and the design can be decorated in colors



GLASS

CARBON

V-Block Fittings for Sawhorse to Hold Round Work



These V-blocks are handy for holding round work on a sawhorse. Pipe and tubing, drive-shaft housings, house gutters, stovepipe and round porch posts are among the many articles that can be accommodated. The blocks are held by dowels, which fit into holes in the sawhorse.

Pencil Line on Floor Disappears When Boards Are Sanded Evenly

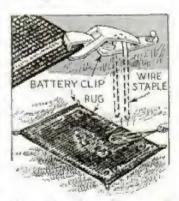
When sanding the edges of a floor the time wasted in running your hand over the boards to see if all high ones have



been cut down can be saved by drawing a pencil line across the board. When the line disappears the boards are even.

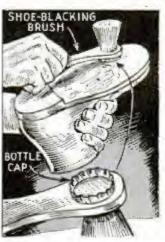
Clips Keep Rugs from Shifting While Beating Them

When beating small throw rugs and others that have a tendency to wrinkle and shift around, you can anchor them to the ground with large battery clips at the corners. Long wire staples



pushed through openings in the clips and into the ground will hold them in place.

Mud on Child's Shoes Removed with Bottle Cap on Brush



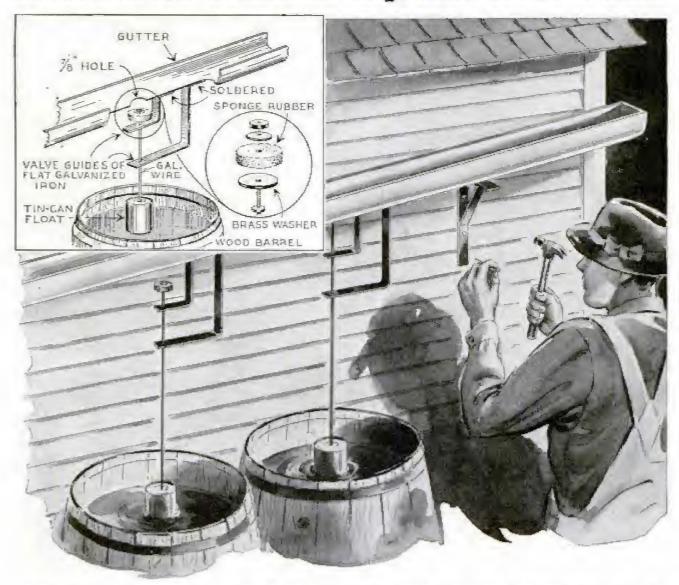
Cleaning and polishing children's shoes may be simplified by using a bottle cap tacked to the back of the blacking brush. The crimped edges of the bottle cap provide a good scraping action for this purpose.

Chuck on Drill-Press Table Grips Round Work

A chuck fitted in the central hole of a drill-press table will be found useful for holding round or other small stock while drilling it lengthwise. A bolt holds the chuck to the table, the work being inserted in the chuck and trued with a level.



Rain Barrels Filled in Sequence from Gutter



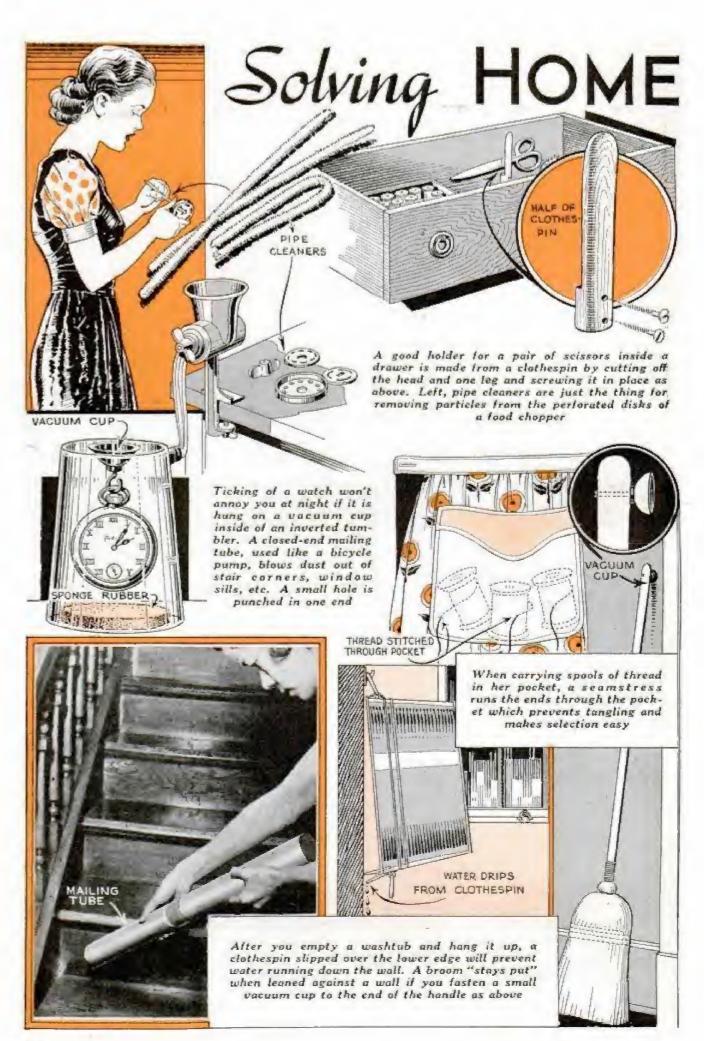
Where more rain water was needed than could be held in a single barrel, the arrangement shown above was used to fill several barrels in sequence. This method was preferred rather than having several barrels fill up at the same time, which could have been done by simply connecting them with pipe near the bottom. The barrels were located close together under the gutter near the end of the building. A drain hole was cut in the gutter for each barrel and a stopper controlled by a floatand-plunger arrangement was provided for each hole. Water flowing down the gutter during a moderate rainfall was drained into the first barrel and as soon as this one was filled, the float on the surface pushed the plunger and stop up against the hole in the gutter, closing it and enabling the water to continue on its course to the next hole. In this way one barrel

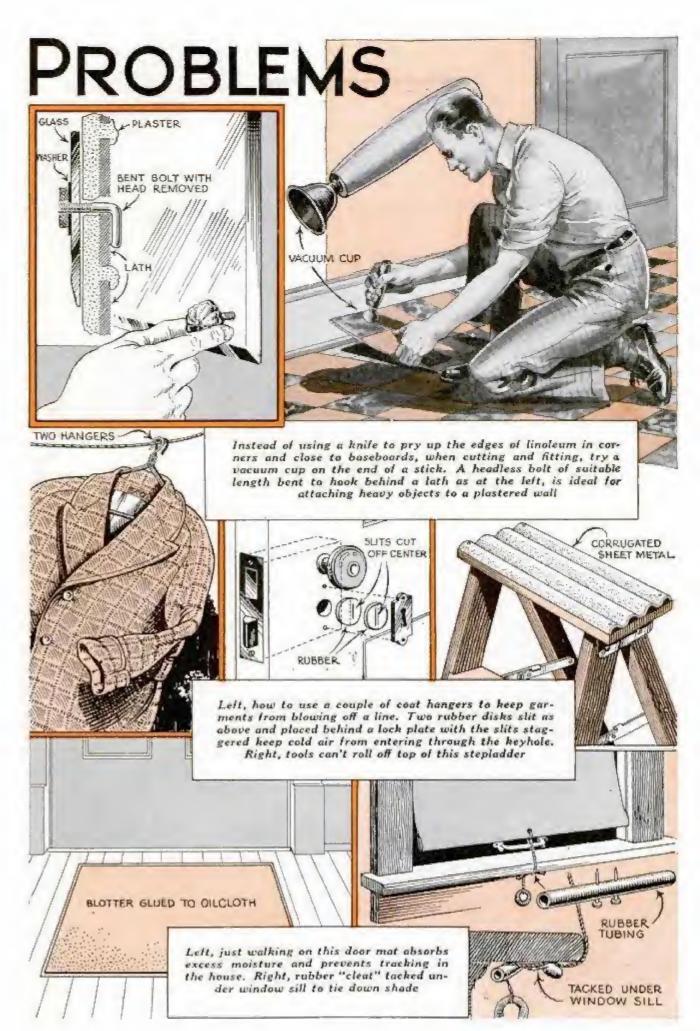
was usually completely filled, which made it easier to remove the water than if all the barrels were partly filled. The last barrel was provided with an overflow pipe to carry surplus water away from the building.

Pipe Opening in Wall Sealed with Paper Cone

The opening around a pipe that passes through a partition can be sealed with the cone-shaped core from a spool of wrapping cord. Just cut the cone in two pieces and force them tightly into the opening.







Hints on Using Your Photo Lights at Home



Folding Photoflash Reflector Is Easy to Carry

Cardboard photoflash reflectors that fold flat and take up almost no space in the camera case can be made in a few minutes from materials available to anyone. Two triangular and two rectangular pieces of heavy cardboard are held together with strips of adhesive tape. The triangular pieces are creased in the center so they will fold inside as shown in the lower detail. A hole in one piece allows the bulb to be slipped through and screwed into the battery case. Tinfoil or aluminum foil is glued to the inside of the reflector.

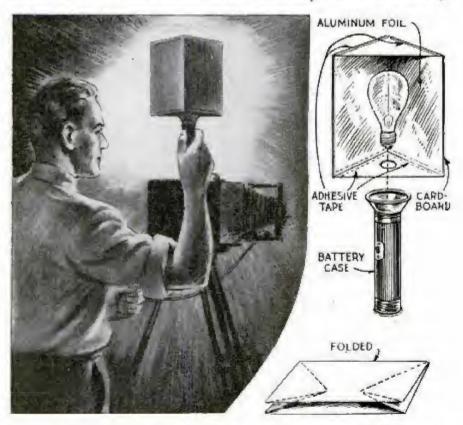


Photo Backgrounds on Track Take Small Space in Studio

Offering a wide variety of background combinations, this arrangement of drapes and sections of wallboard extends only 1 ft. out from the wall of the photo studio. The drapes slide on barn-door track mounted on each side of a 20-ft. rail of 2 by 4-in. stock, which is supported 9 ft. above the floor by ¾-in. pipes in floor flanges. Solid backgrounds (1 and 2 in the photo) and the Venetian blind (4) are fitted with

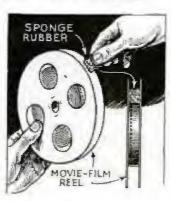
BACKOROUNDS WALL ROLLERS THACK BACKOROUND.

DRAPE 7'X4' FLAT FROM U.

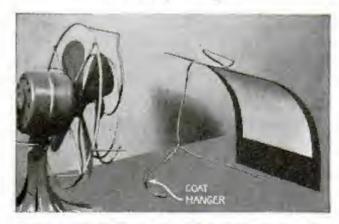
barn-door hangers that roll on the track. Attached to the front of the rail at each end and supported in the center by a flatiron bracket, is a length of 1 by ¼-in. flat iron. On this the drapes are hung by rings. A pole for lifting the drape bar off the center bracket to push drapes beyond that point is shown in the right-hand detail. No. 1 in the photo is a light gray section of wallboard; 2 is a slightly darker gray section; 3, figured drape; 4, Venetian blind; 5, dark gray drape; 6, black drape; 7, dark brown drape; 8, white wall.

Sponge-Rubber Stops in Reel Keep Film from Unwinding

Small cubes of sponge rubber will keep movie film from unwinding. The cubes are compressed and slipped between the disks of the reel and against the end of the film.



Curved Ferrotype Plate Dries Prints Straight



As a photo has a tendency to curve toward the glossy side as it dries, curve the ferrotype inward and the photo will be more likely to be straight when it is removed from the plate. A good way to hold the ferrotype plate in a curved position is to use a wire coat hanger as indicated.

-Jacques H. Upshaw, College Park, Ga.

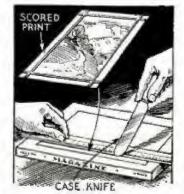
Sun Glasses as Camera Filters

Many amateur photographers have found they can use one lens of a pair of sun glasses as an emergency filter and some have even made up a complete set of filters from lenses of various tints. For emergency use, one side of the glasses can be held in front of the camera lens while the picture is snapped. The normal exposure will have to be increased two to ten times, depending on the tint of the sun glasses. If a permanent set of filters is to be made, they can be mounted in cardboard or metal holders that will slip over the camera lens, and the proper increase in exposure for each one determined by experiment.

—K. F. Keith, St. Petersburg, Fla.

Photos Scored to Avoid Curling

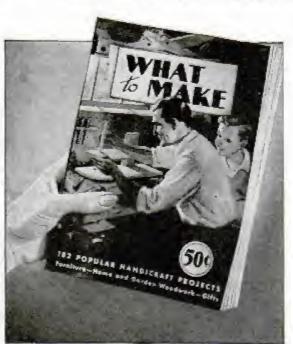
Unmounted photo prints will not curl excessively if the edges are scored with a case knife. Place each print face down on a paper-covered book or magazine and score the edges, using a



ruler as a straightedge. Do not press hard enough to cut the paper.

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PARTIAL LIST OF CONTENTS

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RADIO

EIGHTEEN TUBER
Short Waves

ENTHUSIASTIC short-wave DX-ers (long-distance listeners) demand certain refinements in receiver design that the average set owner knows very little about. Under good receiving conditions most standard "all-wave" receivers bring in distant short-wave

programs that satisfy the average set owner but do not meet the requirements of the exacting shortwave listener, and amateur, who desires to log these DX stations when handicapped with poor listening conditions.

The 18-tube "super-pro" set il-





lustrated is one of the current models of a receiver especially designed for maximum efficiency in the short-wave bands from 71/2 to 240 meters. Sixteen tubes are employed in the receiver proper shown in photos 1, 2 and 3. A separate powersupply unit uses a type-5Z3 highvoltage rectifier and one type-80 low-

voltage rectifier for low voltage and C-bias supply. The speaker is also housed in a separate cabinet. Photo Fig. 2 is a top view of the well-shielded chassis, and Fig. 3 is a bottom view showing the coil and condenser assembly. Outstanding features include: selectivity variable from 16 k.c. to better than 100 cycles; 5-range crystal filter; high sensitivity obtained with two stages of tuned R.F. and three stages of I.F.; noise limiter and an adjustable "S" meter for reporting strength of signals.

455

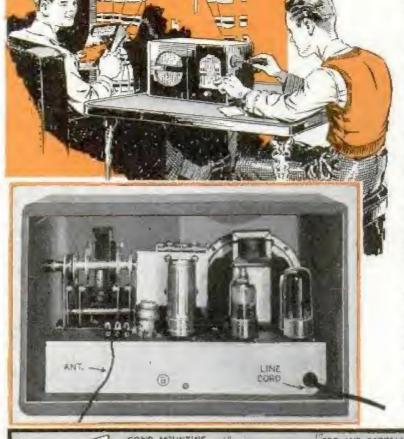


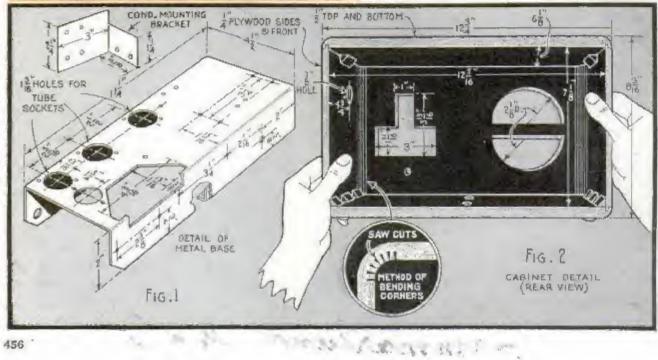
By Frank M. Lund

BY FAR the most popular 4-tube t.r.f. receiver circuit ever described for construction in Popular Mechanics Magazine, this 1940

model offers a simple, practical, low-cost, tuned-radio-frequency 4-tuber of advanced design.

It makes an excellent generalpurpose broadcast set that is easy to build, has good distance-getting ability, excellent tone and a 2-watt output that leaves nothing to be desired in the way of volume. This new model has several outstanding features; it employs a method of mechanical push-button tuning so simple that any novice can set up four favorite local stations in less than 5 minutes. Setting up these four stations does not interfere in any way with the usual manual tuning of the set. Other features include, permanent-magnet dynamic speaker, a.c.-d.c. operation, and four of the very latest high-filament-voltage tubes that do away with the line-cord resistor or ballast tube usually employed in





GIANT
AC. D.C. FOUR TUBER

MANUAL

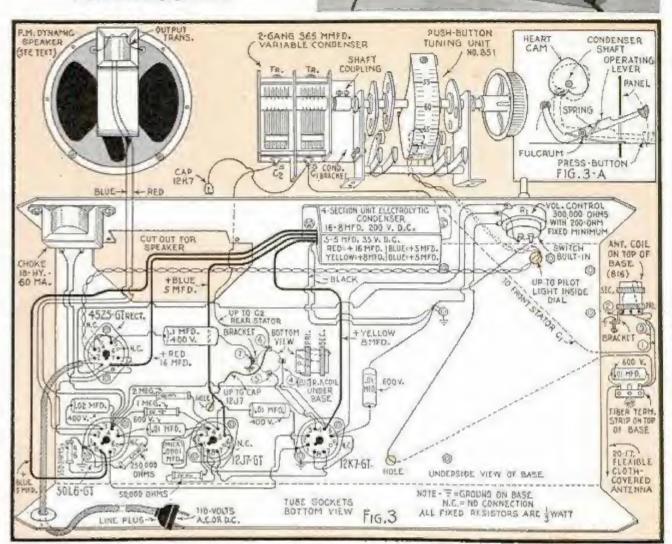
ANT.

a.c.-d.c. receivers. The line voltage is distributed between the tubes, and the current drain is about one-half that required for similar tubes of older design. Heating is reduced to a minimum, and the 45Z5-GT rectifier tube is provided with a heater tap so that a single pilot lamp can be

single pilot lamp can be lighted to normal brilliancy.

The sheet-metal chassis base and condenser mounting bracket are detailed in Fig. 1; these may be homemade, or, they can be purchased formed and drilled if desired. Fig. 2

(Continued to page 132A)

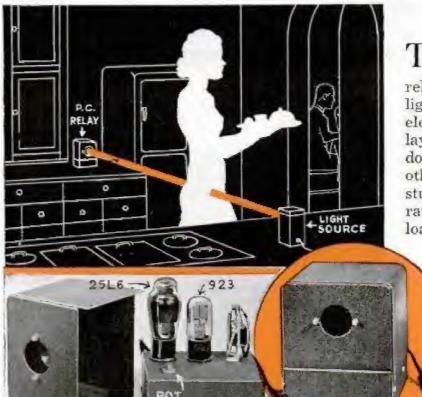


0

(A)

(a)

Photocell-Operated Relay for Experimenters



By L. L. Worner

THIS easily assembled low-cost photoelectric-cell-operated relay is heavy enough to turn lights "on" or "off," operate an electric counter, actuate other relays to operate electrically driven door-opening devices and many other applications of interest to students and experimenters. It is rated at 5-amp. non-inductive load and 1-amp. inductive load at

110 volts.

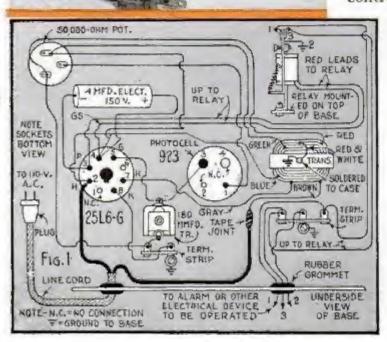
Photos A, B and C show various views of the completed instrument. The chassis base and cover with mounting holes drilled, and all radio construction parts are available in kit form from mail-order parts houses. The sheet-metal base is 5 in. long, 4 in. wide and

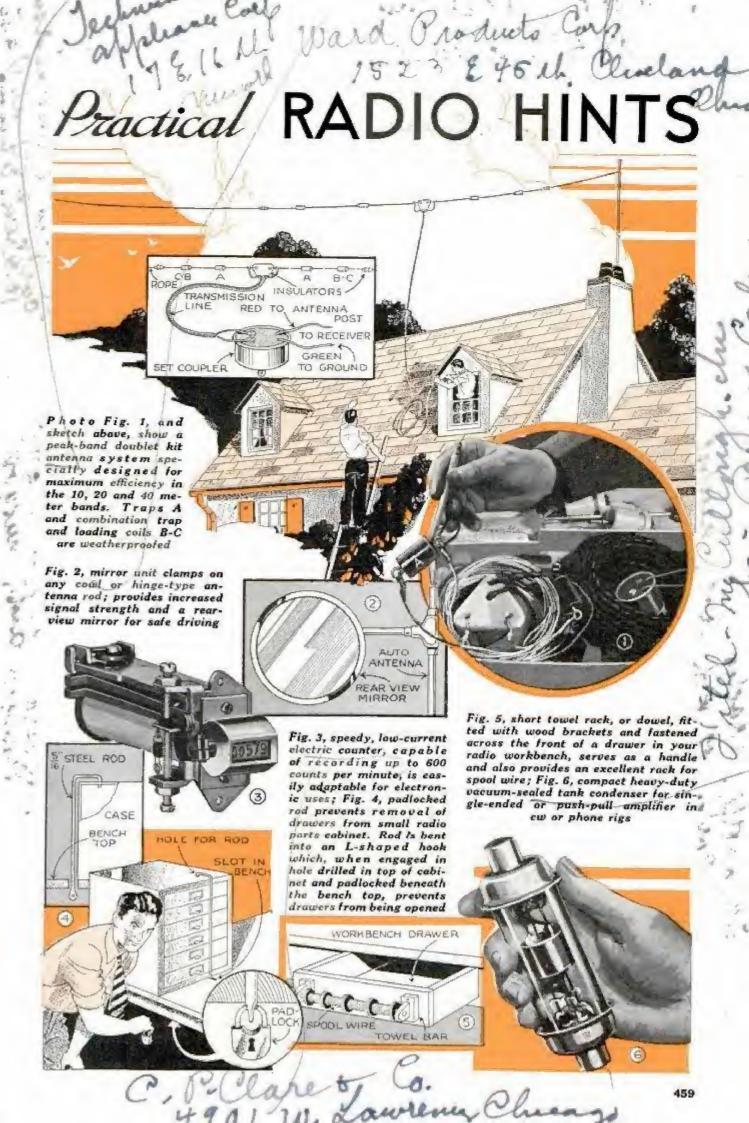
2 in. high, and the cover extends 4 in. above the top of the chassis base. This cover is provided with a recessed lens holder in case the builder wishes to use a condensing lens. Although the instrument can be used without the cover for certain applications, the cover is necessary to prevent extraneous light from falling upon the photocell when a beam of light is used to control the operation of the relay.

Only a handful of parts is required and these are all plainly specified in wiring diagrams Fig. 1 and Fig. 2. Mount tube sockets with terminals as shown in diagram Fig. 1. The transformer is mounted on the side of the base. Please note that the compression-type trimmer condenser is supported directly on the insulated lug on terminal strip.

To test and adjust the instrument, turn the potentiometer to the extreme left. Connect a milliammeter, of 0 to 25 m.a. range, with the positive terminal to the No. 8 pin of 25L6-G, and the negative terminal to ground. Cover the photocell so that light cannot fall on it, plug

(Continued to page 136A)





Automatic Tube-Tester Unit Employs Card Index



Operating in a manner similar to a time clock, this device automatically tests shorts, leaks and all important functions; 185 index cards cover 580 tube types. Operator simply places tube in socket, inserts proper punched card from index into slot until stop is reached, and pulls lever.

Seven-Station Office System



Up to seven of these "multiple master" stations may be used for inter-office communication. Each station unit consists of an a.c.-d.c. amplifier, power

supply and microphone speaker. Transmission occurs only while push-to-talk switch is down, otherwise unit is in receive position.

A, B, and C-Battery Eliminator

Where 110-volt, 50-60 cycle a.c. current is available, this small "battery to allelectric converter" can be used to supply A, B and C power to battery sets designed for



3-volt dry battery, 2.5-volt air cell or 2 volt storage cell "A" power.

Improved Wireless Record Player

Housed in a case of mahogany-colored plastic material, this inexpensive record player has a 3-position power switch, crys-

tal pickup, self-starting electric motor and
employs two tubes.
No wired connections
to receiver are necessary, and records
can be played from
any location in a room.

■Blueprints covering radio construction articles in this and past issues are available for 25 cents each. Original material lists, with names of manufacturers and dealers, can be obtained from our Radio Department upon receipt of postage.

NEXT MONTH—How to Build a Loop-Operated Battery Portable. This compact little set uses four of the 1.4-volt, low-drain tubes, has its own built-in loop antenna and can be installed in any sort of carrying case the builder may prefer. Also—Homemade Telescoping Antenna Mast. Rugged construction, easily raised.



SHOP NOTES

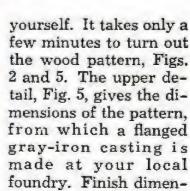
Precision CHUCK BACKS machined on your lathe

- CASTING

(2)

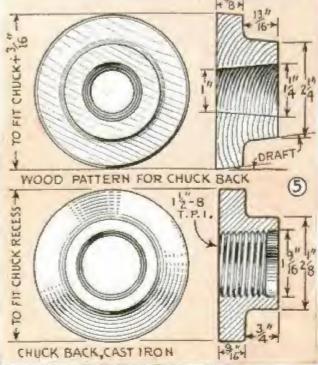
By C. W. WOODSON

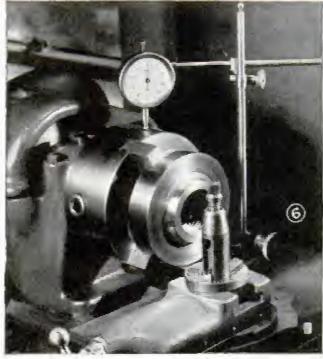
INLESS you purchase your workshop metal-turning lathe already equipped with a complete kit of accessories, machining and fitting a chuck back, or chuck plate as it is frequently called, is one of the first jobs you will get into when you "tool up" for more pretentious work. Although there are certain niceties in machining the chuck back to fit, the job is one of the easiest and simplest of all precision operations on the small lathe. Also, you will save several dollars by doing the whole job



sions of the casting, lower detail in Fig.







useful for adjusting the depth of cut, Fig. 3. Many passes of the tool will be needed to cut the threads to the full depth. Test for fit on the lathe spindle occasionally. When doing this leave the work attached to the faceplate. After a close fit has been obtained the chuck back is screwed on the lathe spindle and smoothly faced with a sharp cutter bit and the flange turned down to a push fit in the recess of the chuck, Fig. 4. Keep in mind that a "push" fit means a very close tolerance, so you will have to check often when the flange nears the finish dimension. Bolt holes in the chuck can be spotted on the chuck back by chalking the face rather heavily, inserting in the recess of the chuck and tapping with a soft hammer. The edge of the bolt holes will make an impression on the chalked surface of the plate. Lay out and drill the holes 1/16 in, larger than the diameter of the bolt. Be sure that the drill does not run when the holes are started. To prevent this it might be well to put through a pilot hole first. If you get one hole off it will mean reaming this hole oversize, which is not so good. Although true running of the chuck will perhaps be little affected due to the push fit of the parts, the shearing strain of heavy cuts on work held in the chuck comes on the capscrews. When you're sure the holes are right, screw the back to the chuck, drawing the screws up with equal pressure as in Fig. 1. Then turn the chuck on the spindle, clamp a piece of circular work in the jaws and test the work and chuck with a dial indicator, Fig. 6.

Funnel Cap Prevents Evaporation of Volatile Fluids

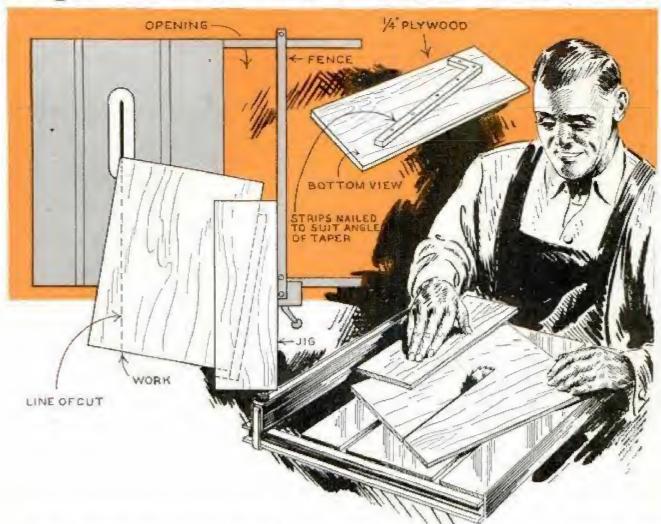
The necessity of pouring volatile cleaning fluids into open-mouthed vessels for use in dry-cleaning stores adds to the expense for such materials by rapid evaporation. One cleaner avoided much of this loss



CLEANING FLUID

by using a small funnel, with a cork in the spout, as a handy cover that could be removed or replaced in an instant.

Angle Guide on Saw Handles Wide Work



If you have tried to make an angle cut, on a circular saw, along the edges of stock that was wider than the saw table, with the aid of a conventional jig for sawing angle cuts, you can well appreciate the value of this jig for the purpose. As you can see in the drawings, the work supports the jig as it passes over the opening between the table and the rip fence, whereas

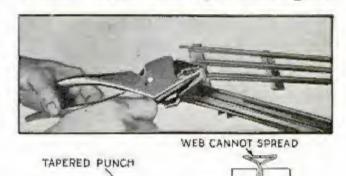
the regular jig would fall between the fence and table to the floor. The jig consists simply of a piece of plywood having a cleat nailed to its underside at an angle to suit the angle of the cut to be made. A short block nailed at right angles to the cleat engages the rear corner of the work next to the fence.

-Wayne C. Leckey, Aurora, Ill,

Damaged Ends of Toy-Train Track Are Easily Reshaped

When the ends of toy-train track are damaged so that the connecting pins do not hold, a jig made by slotting one side of a nut is handy in reshaping them. Just slip the nut over the end of the rail as indicated and shape it with a tapered punch. The nut keeps the web of the rail from spreading and also aids in rounding the end.

Paint can be removed from reed furniture with a solution made by mixing trisodium phosphate, 3 lbs., in hot water, 1 gal.



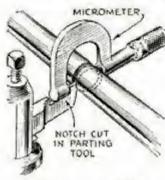
SPLIT NUT

Special Mounting Permits Vise to Be Turned Any Direction



Used at a welding table, this mounting permits a vise to be swung completely around in a horizontal plane, or tipped to either side. The mounting consists of two lengths of pipe, one to fit snugly inside the other. One end of the larger pipe is fastened to a table or bench and the other end is slit back along one side a few inches. Lugs welded on each side of the slit and drilled to take a tightening bolt permit the pipe to be drawn up to grip the smaller pipe. The outer end of this pipe carries the vise, which is swiveled to it.

Measuring Narrow Grooves



When narrow grooves had to be cut to an accurate depth in round work the following method of measuring them was adopted, as a micrometer could not be used in the

ordinary way. The parting tool has a clearance slot on top so that a micrometer can be used. It is brought up to just scrape the work and the over-all dimension noted. This groove had to be exactly ½ in. deep so the parting tool was advanced until the over-all dimension No. 2 was ½ in. less than the first over-all dimension when the tool was just scraping.

Emergency Repair on Grain Sacks Made with Adhesive Tape

Confronted with the problem of immediately repairing some torn sacks containing expensive seeds, a Wisconsin seed merchant found that the mending



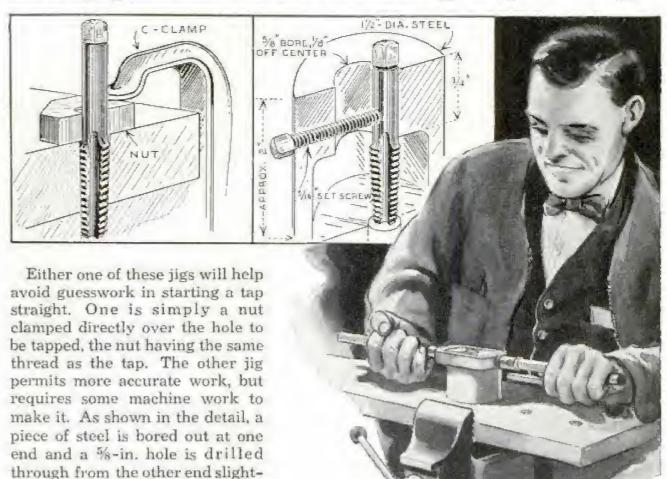
could be done with strips of adhesive tape. The area to be repaired was cleaned with a cloth moistened in gasoline and the patches applied as shown. The cloth must be merely dampened with gasoline.

Clevis Pin Kept in Doubletree by Rubber Strip

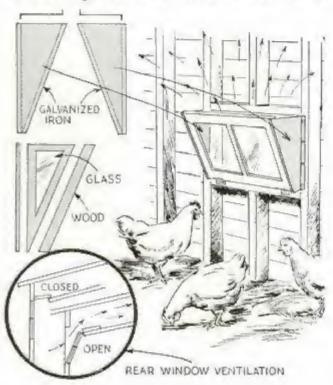
When using a team of horses with a chain and doubletree to move objects, the pin can be kept from slipping out of the clevis with a strip of old auto casing. This is nailed to the doubletree so that one end extends over the pin as indicated.



Two Jigs That Aid in Starting Taps Straight



Poultry-House Window Is Hung for Draftless Ventilation



ly off center. A setscrew driven in from one side bears lightly against the tap to hold it in alignment.

> You can have fresh air without drafts, for ventilation in a poultry house, by nailing triangular fins or wings to the wall so that a window can be opened partly as indicated. The fins can be made of wood or sheet metal. If the latter is used, flanges are bent on one side of each fin for nailing and on the other to serve as window stops. When wood is used, cleats nailed to the sides of the fins take the place of flanges. If desired, glass can be set in the wood fins to admit additional light. When the window is in the rear wall, an opening can be made in the ceiling and the window hinged so that air is directed through it. This current of air passing through the ceiling tends to pull foul air from the lower part of the building. A flap or door should be provided to close the ceiling opening when the window is closed.

—Ed. Ahrens, Vanderbilt, Mich.

Bottled Goods Displayed Neatly with Theftproof Rack



Faced with the problem of displaying bottled goods so that it would be difficult for anyone to remove one of them while his attention was distracted for a moment, one merchant used the rack shown. Necks of the bottles fit in notches cut in the rack where they are held by a molding strip. The bottles cannot be removed without first taking off the strip, which is fastened in place with screws.

Screwdriver Has 'Hammer Knob' to Remove Painted Screws

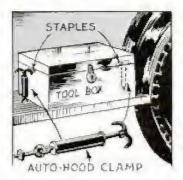


Confronted with the job of removing and replacing a number of seats in railway cars, a workman found that paint in the screw slots made it almost impossible to insert the blade or point of

the screwdriver. To overcome this difficulty without using a small chisel to remove the paint, he had a "hammer knob" welded onto the side of the screwdriver. By tapping on this with a hammer, while operating the ratchet brace, the driver was made to engage the slot instantly.

Auto-Hood Clamps Hold Toolbox on Car Running Board

To carry a box of light tools on his car where it would be convenient, a furnace repairman attached a pair of autohood clamps to the running board to engage staples in-



to the ends of the box. In this position, it is not necessary to unload heavy equipment to get at or replace the tools.

Paper Stencils Made Quickly by Using Glass Cutter

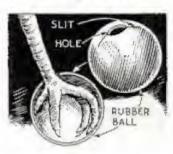


A sign artist who had many stencils to cut from heavy paper found that a glass cutter was just the thing for the job. If the work is laid on a pane of glass, the cutter makes a clean outline, and

can be manipulated to accommodate curves and sharp corners in the design.

Hobble Cures Broody Hen

A petty but constant annoyance will usually break up the broodiness of the most persistent hen. One of the simplest and easiest remedies is a hollow rub-



ber-ball "hobble." A hole is made in the ball to fit comfortably around the leg of the fowl, and slits from this permit the opening to be enlarged sufficiently to receive the foot. Wearing this hobble for a day or so will not injure the bird. from PATTERN to CASTING

PART III

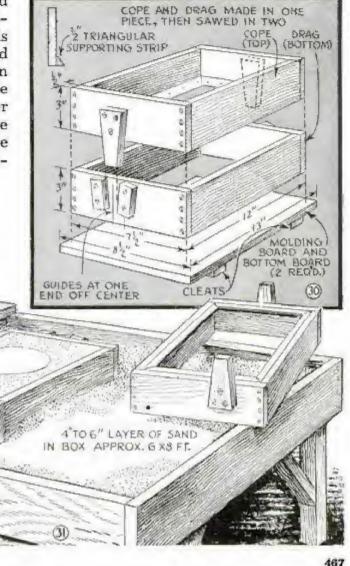
Foundry Methods-Sand Molding

MAKING castings successfully involves the use of a carefully made pattern for the construction of a sand mold, melting of the metal, and finally the pouring of the mold. Once the pattern has been completed, it is not a difficult task to prepare the mold and cast the metal. By following through with details carefully, anyone can make small castings readily out of such metals as aluminum, brass, pewter and other low-melting alloys. Although essentially the same methods apply, the higher temperatures involved render casting from iron and steel impractical for the small home shop.

Castings are ordinarily made in a sand mold. The mold is prepared from the pattern in a box, generally of wood, which is called the flask. The latter is constructed according to the general plan outlined in Fig. 30, which gives dimensions suitable for small castings. Large flasks or smaller ones also can be prepared according to the same general plan. The two parts of the flask, called the cope and drag, are con-

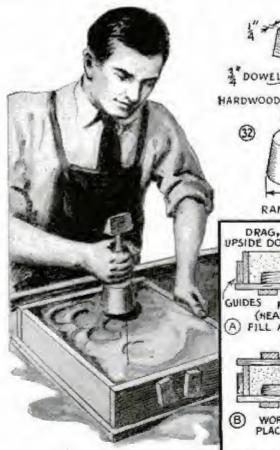
GAS FURNACE

ELECTRIC BLOWER



(32)

RAMMER



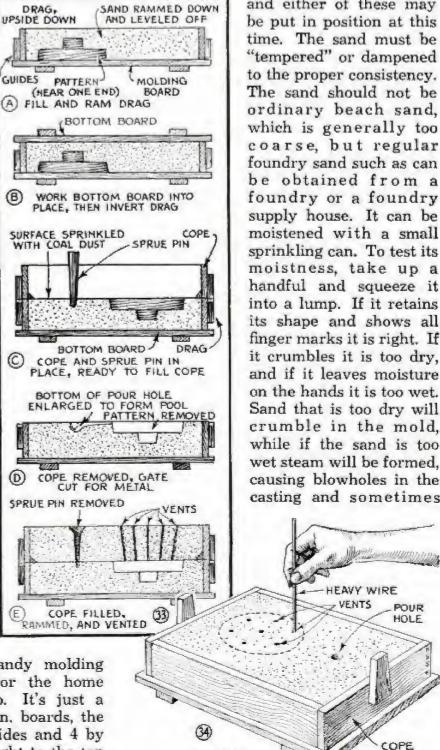
a trifle lower than standard table height. This is an aid in handling the heavy sandfilled flask and the ladles or crucibles of molten metal.

Preparation of the mold is begun by placing the drag upside down on the molding board, A, Fig. 33, and placing the pattern in position, with parting surface down and near one end of the flask, as shown. If the draft of the pattern runs both ways from the parting line, the pattern will have

> been made in two pieces and either of these may be put in position at this time. The sand must be "tempered" or dampened to the proper consistency. The sand should not be ordinary beach sand, which is generally too coarse, but regular foundry sand such as can be obtained from a foundry or a foundry supply house. It can be moistened with a small sprinkling can. To test its moistness, take up a handful and squeeze it into a lump. If it retains its shape and shows all finger marks it is right. If it crumbles it is too dry, and if it leaves moisture on the hands it is too wet. Sand that is too dry will crumble in the mold, while if the sand is too wet steam will be formed. causing blowholes in the casting and sometimes

structed as one piece, then the wedges and cleats which make it possible to align the cope and drag are fastened in place with flat-head wood screws. The guides at one end should be off center so that it will be easy to realign the parts. The long wedge is then removed, the flask is sawed in half to form the cope and drag, and the wedges are replaced. A triangular strip is nailed on the inside of the cope to help retain the sand. When two flat boards (molding board and bottom board) of the size shown in Fig. 30 are prepared, the flask . is complete. Fig. 31 gives

you a suggestion for a handy molding bench, entirely practical for the home foundry or the small shop. It's just a roughly built affair of 11/8-in, boards, the latter for the bottom and sides and 4 by 4-in. stock for the legs. Height to the top of the bench sides should be about 28 in.,

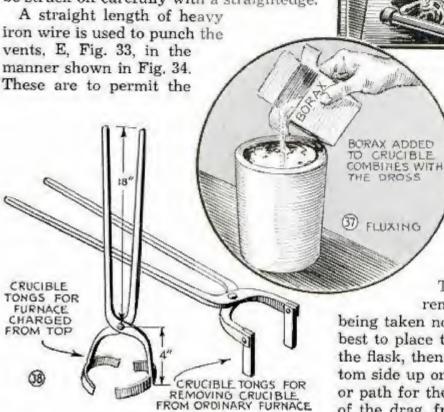


VENTING

dangerous blowing out of the molten metal.

The sand is spread over the pattern and rammed down firmly with a rammer, such as is shown in Fig. 32. The wedge-shaped end is convenient for ramming close to the edges of the flask. When the drag is filled and rammed, level off the top with a straightedge, sprinkle a little dry sand over the top, and place the bottom board on top. as at B in Fig. 33. Rub the board around until it rests firm without rocking, then grasp the drag and the two boards firmly between your hands, and turn the drag over. Slip the molding board off and sprinkle fine coal dust or parting sand from a cloth bag over the surface to aid in parting. Excess coal dust or parting sand should be blown off. For this operation a hand-operated bellows is very useful.

The cope is now put in place and a tapered pin set into the sand a few inches from the pattern as shown at C in Fig. 33. This is called the sprue pin and forms the sprue or pour hole. If preferred, the sprue pin can be omitted and the pour hole cut with a sharpened length of ½-in. pipe, or preferably tubing, after the cope is filled. If the pattern is in two pieces, the upper half is put in place at this time. When these preparations are finished the cope is filled with sand and rammed down in the same manner as the drag was. The top should be struck off carefully with a straightedge.





escape of gases evolved
when the hot metal is
poured, and should be
about an inch apart over
the entire face of the
pattern. After the vents
are finished, the sprue
pin is removed and the
mouth of the pour hole
enlarged to funnel
shape, so that the mold
appears as in D, Fig. 33.
The cope is now temporarily

removed and set aside, care being taken not to damage the mold. It is best to place the molding board on top of the flask, then lift the cope and set it bottom side up on the molding board. A gate or path for the metal is cut in the surface of the drag, from the bottom of the pour



hole to the pattern. A small pool can be dug at the bottom of the pour hole. A spoon or trowel should be used to cut the gate, and all loose sand must be removed or tamped down carefully. A draw spike is driven into the pattern, the pattern is carefully rapped all around, and then is lifted from the mold. Any loose sand may be removed, and all breaks in the mold must be repaired. If the pattern is in two parts, the cope should be laid upside down on the molding board while the upper pattern is removed. The mold is now completed and it is only necessary to place the cope back in place on the drag.

A number of metals will be found suitable for casting, among them brass, aluminum, lead, tin, zinc, Brittania metal, pewter, and the like. Where alloys are used it will be just as satisfactory and cheap to buy them already alloyed, rather than attempt to prepare the alloy yourself. The metal should be melted in a

crucible, either of clay or graphite or of iron. A cheap substitute for a crucible can be made from a pipe nipple and a malleable iron pipe cap. The cap must be of malleable iron to stand heating. For small quantities of soft metal an iron ladle with a long handle will be found convenient. The melting preferably should be carried out in a special gas furnace, such as the one shown in Figs. 31 and 39. This one is gas fired and is fitted with an electric blower. The softer metal also can be melted in the basement furnace, as shown in Fig. 35. The crucible should be covered, and the live coals banked around it. Low meltingpoint metals such as lead and pewter can be melted on an ordinary gas plate or stove, Fig. 36. In all cases a small amount of borax should be added to combine with the dross that is formed. This is called fluxing, Fig. 37. Crucibles should be handled with a pair of crucible tongs. Blacksmith's tongs to which iron jaws have been riveted as shown in Fig. 38 will be found most convenient for handling the crucible and pouring the hot metal.

Because of the high temperatures involved, it is most important to be sure that no molten metal strikes wood, paper, or anything else inflammable. In all cases, a clear gangway should be left open between the molding bench and the furnace. It is also wise to work over a bed of dry sand, especially if the shop floor is of wood. It is necessary to make sure before you lift the hot crucible from the furnace that you have a firm hold on it with the tongs. Special precautions always must be taken to

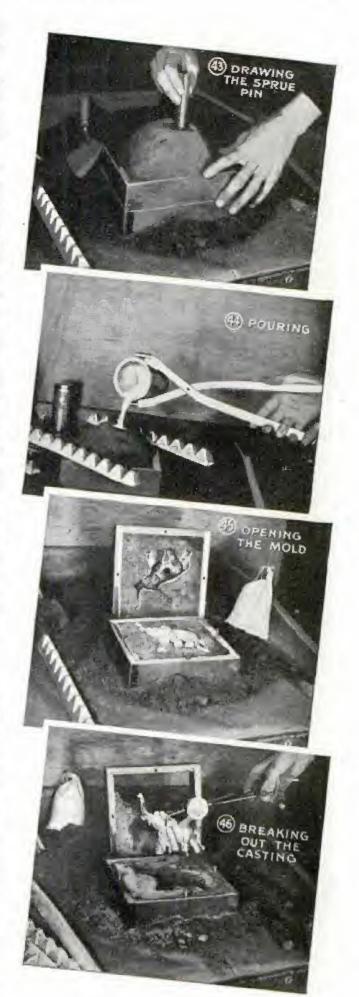


offset any chance that the crucible might slip from the tongs and spill metal on the floor or on your hands or clothing.

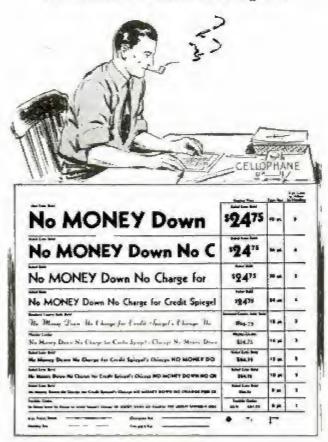
The two halves of the flask must be held together as there will be a tendency for the cope to float when the metal is poured. One method is to lay a heavy slab of stone

or metal on top of the mold.

When the mold is prepared and the metal is molten, it should be poured against the side of the sprue hole so that it flows gently into the mold. The crucible should not be held so high that the liquid will fall with excessive force. When the mold is filled it should be set aside until the metal has solidified. The excess metal in the crucible should be poured into a cavity in the sand, and allowed to cool. The "pig" thus formed can be remelted when needed. The metal never should be allowed to freeze in the crucible. Finished castings can be ground and polished as required. The molding sand can be used again but about 20 to 25 per cent of new sand should be mixed in at frequent intervals. Figs. 39 to 46 inclusive picture a variation of methods already described. Here any number of castings can be made from the same pattern, but it is necessary to ram up the mold for each separate casting. Frequently this is easier to do than making up a parted pattern, especially if the pattern is of irregular shape or is composed almost wholly of rounded or curved surfaces. In this method the drag is rammed right side up before the pattern is placed in position. The sand should be a trifle less moist than that used in the conventional procedure. After the drag has been rammed and struck off, the one-piece pattern is bedded one-half its thickness in the sand and the latter is leveled and parted as shown in Figs. 41 and 42. Then the cope is placed in position and rammed to complete the upper half of the mold. The remaining steps will be self-evident from examination of the illustrations. The cone of sand built up around the sprue pin as shown in Fig. 43 is sometimes a help when you are casting from a small pattern which has a projection extending well up into the cope. Frequently, in making small castings, the mold is not gated in the manner described, but instead the sprue pin is inclined slightly to form a slanting hole down which the molten metal runs directly into the mold.



Type Sheets to Help Visualize Headlines and Price Spots



If you have considerable printing done, ask your printer to make up type sheets on clear celluloid showing the points and faces of type you intend to use for headlines, subheads, prices, etc., similar to the example given. With this transparent sheet you can determine better the space required for headlines, etc., as well as see how the type suits the page. The type sheet should be of the same size as the pages to be printed.

Lathe Work Turned Off Center Balanced by Weights

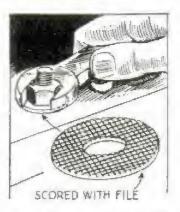


Vibration caused by lathe work turned off center can be reduced by using a counterweight on the faceplate. The weight consists of metal disks held in place by a bolt in one of the faceplate slots. A number of the weight disks of various thicknesses can be made up so that any work can be balanced quickly.

-S. J. Gancher, Richmond Hill, N. Y.

Scored Surface of Washer Prevents Turning

When assembling wood parts with bolts, where washers are used under the nuts, score the undersides of the washers with a file. When a nut is turned down, the scored surface of the washer will be



forced into the wood surface and it will not turn as the nut is tightened.

Rubber Hose Keeps Flags Furled When Not in Use



To keep his warning flags closely
furled so that they
will not become
soiled or torn easily
when stored in
trucks, one contractor employs lengths
of lawn, or radiator
hose. These are slit
along one side to

slip over the furled flag. When not in use, the hose may be slid down onto the staff.

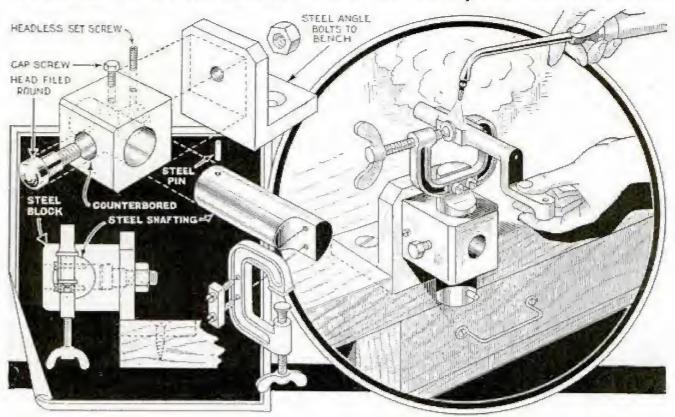
Brush Aids in Soldering Uneven Surfaces

When soldering pieces of corrugated metal together, a tinsmith uses a stiff-bristled scrub brush to apply pressure to hold the parts in place. The surfaces of the bris-



tles shape themselves to the work so that it is held in close contact.

Welder's Universal Vise Is Easy to Assemble



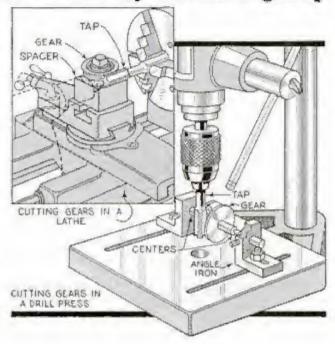
Adjustable to any angle in any plane, this vise is just the thing to hold small parts while welding, brazing or soldering them. It consists of a steel block drilled to take a small steel shaft, which carries a C-clamp on one end to grip the work. After adjustment, the shaft is locked by a cap screw bearing on it. By use of a clamp bolt the block is pivoted to a steel angle

which is screwed to the bench. The clamp bolt fits in a hole in the block, the hole being counterbored to permit the bolt head to clear the shaft. A headless set screw tightened on the bolt head, which is filed round to slip into the counterbored hole, helps to hold the adjustment after the bolt nut has been tightened.

-J. A. Honegger, Bloomfield, N. J.

Teeth Cut on Worm Gears with Ordinary Threading Tap

Anyone who has access to a lathe or drill press can make small worm gears with ordinary taps. First, turn the gear blank to size. Then cut a shallow groove around its face to the same contour as that of the tap to be used. The gear blank must be mounted so that it turns freely, and the machine must be run very slowly, taking care to see that the blank rotates in relation to the tap, using the hand to help it rotate through the first two or three revolutions. In a lathe, the tap is held in a chuck and the cutting end is supported by the tailstock for rigidity. On a drill press, it is necessary to put the gear blank on an arbor and mount it between centers supported securely on the table by means of angle irons as indicated in the lower detail.



Temporary Window Lettering Done in Colors



Window signs for special sales will wear well, yet be easy to remove, if the lettering is done with soap and ocher powders. The lettering is first marked with yellow soap, after which the ocher powders in colors are applied with pounce bags. The powder will adhere to the soap and make an attractive sign.

Waste of Live-Stock Feed Avoided by Shields on Ends of Trough

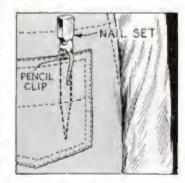
Cattle are not likely to throw feed out of this trough with their noses, because of the shields on the ends and the crosspieces through the center. Notice that the shields



tip inward, thus deflecting any feed that is thrown against them back into the trough. Also, the crosspieces tend to prevent the cattle from swinging their noses from side to side to throw out the feed.

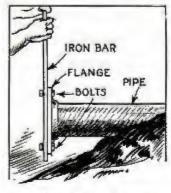
Pencil Clip Keeps Nail Set in Your Pocket

Carpenters who carry nail sets in their pockets will find pencil clips just the thing to keep them from slipping out. Also, a clip prevents the pointed end of the nail set from com-



ing in contact with the bottom of the pocket where it quickly wears a hole through the cloth if carried in the usual way.

Large Pipe Flange Removed with Iron Bar



When a large pipe flange has to be removed and a suitable wrench is not at hand, try a long iron bar. Just attach it to the flange with a couple of bolts on opposite sides as indicated, and use it

as a handle to loosen the flange.—P. Cowley, Benoni, Transvaal, S. Africa.

Brush Holder on Artist's Palette

Instead of holding my artist's brushes in the same hand that holds the palette, which tires the hand on long jobs of oil painting, I attached a holder to the palette for



them. The holder is simply a coil spring having the coils stretched to permit inserting the brush handles.

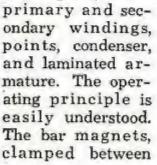
—L. B. Robbins, Harwich, Mass.

Oscillating-type MAGNETOS EASILY TESTED AND SERVICED

EASILY TESTED AND SERVICED

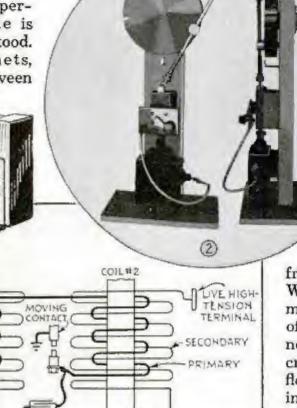
By JACK BEATER

NE of the most popular types of oscillating magnetos, which is used extensively on small one-cylinder gas engines supplying power for boats, lighting plants, light machinery and pumps, cannot be tested on any ordinary type of generator or magneto test bench as the magneto has no rotating parts. The crossbar or "armature" of this magneto is "kicked" up and down on the pole ends to make and break the magnetic field, and to open and close the primary circuit. It is a simple high-tension magneto, consisting mainly of two laminated pole pieces, eight plainbar magnets, two coils containing both the



GROUNDED END OF

GROUNDED



CONDENSER

FRAME OF MAGNITO SECONDARY OF COILS

CIERREPRON A

CIRCUIT DIAGRAM OF OSCILLATING -TYPE MAGNETO

GROUNDED ON

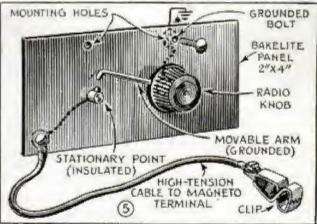
LAMINATED

SPEING CONNECTING

the pole pieces, supply the initial energy and make one pole piece a north pole and the other a south pole. The coils are hollow and slip over the pole pieces. The laminated crossbar, or armature, rests upon the tops of the pole pieces and provides a path for the magnetism to travel

from the north to the south pole. When the engine mechanism moves the crossbar from the tops of the pole pieces, the flow of magnetism is interrupted. This action creates an electrical current that flows through the primary windings of the two coils. An instant after the crossbar has left the pole tops the continued movement of the crossbar opens the points, and the current flow in the primary is suddenly interrupted. This inter-





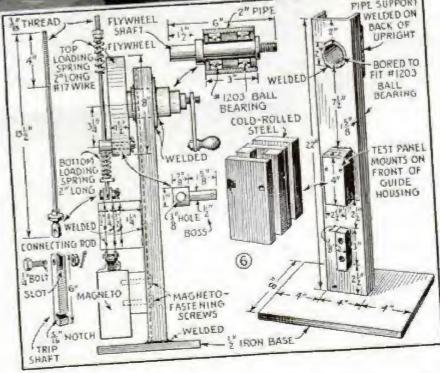
coils is made by a short coil spring insulated with varnished tubing. The terminal button on one coil is always grounded to the outer cover, while the other button connects through a small coil spring to the high-tension terminal

> of the magneto. The paths of the primary and secondary circuits are shown in the circuit diagram, Fig. 3. The coils can be tested on one of the standard magneto coil testers such as that shown in Fig. 4.

> The construction of a test stand for this magneto is shown in detail, in Figs. 5 and 6. The channel-steel upright is welded to the steel base plate. Above this a small steel block is welded to the upright to hold the magneto in the right position for testing with the crossbar down, Fig. 1. Immediately above the magneto, the trip-shaft guide block is welded to the frame. The guide block is

assembled from ordinary square and flat steel stock and spot welded together. Near the top of the upright a 3-in. length of 2-in. pipe is welded through and at right angle to the frame. Before welding into place, this pipe is machined inside to take the two ball bearings used to support the flywheel shaft. The flywheel can be of cast iron or steel and is a press fit on the shaft. A floating boss is mounted in a drilled hole near the rim of the wheel and controls the action of the spring-loaded connecting rod.

The latter is made of %-in, cold-rolled



ruption induces a high-voltage current in the secondary windings of the coils that passes out of the magneto terminal and to the spark plug. The engine mechanism then returns the crossbar to its original position on the ends of the pole pieces,

completing the cycle.

The coils of this magneto are quite rugged but occasionally become defective due to excessive moisture or other causes. The high-tension terminal of each coil consists of a small brass button, and the high-tension connection between the two steel rod, threaded at one end and heated and flattened at the other. A turned collar at the bearing end supports the bottom loading spring, while the tension of the top loading spring is adjusted by means of a nut and lock nut. The loading springs are of the coiled-wire type.

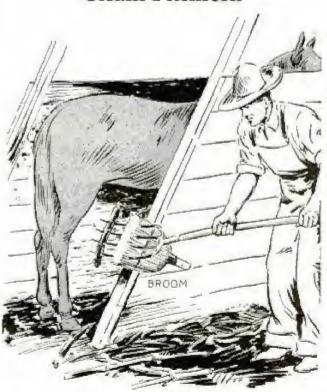
The trip shaft is easily made from ¾-in, square steel bar. It must be notched at both ends as shown and must slide freely in the guide. A crank handle can be provided on the flywheel shaft for manual operation, or a pulley for motor drive.

Now, in operation the floating boss compresses the top spring as it moves upward. Slightly before top dead center the coil spring is fully loaded and the continued movement of the boss "bumps" the connecting rod upward. The latter being engaged with the lifter pin of the crossbar on the magneto, snaps the armature from the pole tips and pulls it upward as the spring unloads tension. The bump of the flywheel boss on the fully compressed loading spring causes the initial separation of the armature from the pole tips but the balance of the snappy upward movement of the armature is caused by the unloading of the top coil spring. On the downward half of the cycle the flywheel boss loads the lower coil spring and re-engages the armature with the pole tips. Unless the armature makes a good contact with the pole tips after each spark the magneto will miss on the next revolution. Hence the lower loading spring is important but not critical in adjustment.

A small Bakelite panel is mounted above the magneto on the front of the trip-shaft guide housing, Figs. 2 and 5. The panel is fitted with an adjustable spark gap for checking the condition of the spark. A high-tension cable and clip are permanently attached to the panel for connection to the magneto high-tension terminal.

When operated by hand the magneto can be tested at any speed, from one revolution per minute up to several hundred or more. Because it duplicates the tripping action as found on all engines using this type of magneto, the tester can be depended upon to prove the condition of the magneto before it is put back into service. The tester shown here was designed and built in a magneto repair shop, where it has given splendid results.

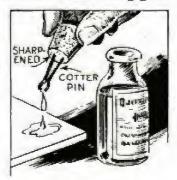
Discarded Broom on Horse Stall Cleans Pitchfork



The annoyance of having cornstalks become impaled on the barn fork may be overcome by nailing a section of a discarded broom onto the side of the stall. It takes just a moment to draw the tines of the fork through the projecting bristles of the broom and clean them thoroughly. If desired, flat-iron brackets can be attached to the stall so that the broom pieces can be inserted or removed without the use of a hammer and nails.

Cotter Pin Makes Good Dropper

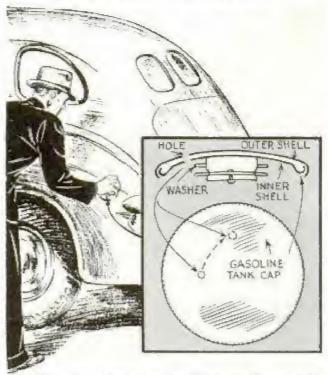
When a dropper is needed for applying liquids in a workshop or garage, open a cotter pin slightly, file the ends and force them into the cork of the bottle. When the head of



the key is inserted into the liquid and lifted, the liquid can be applied drop by drop.

(IStains on white enameled stoves often can be removed by rubbing the spot with a paste made of scratchless cleaning powder and kerosene.

Gasoline-Tank Cap Altered Easily to Make It Theftproof



If the cap on your gasoline tank consists of two parts similar to the one shown, it is a simple matter to make it difficult for a thief to remove the cap unless he knows the secret. Squirt penetrating oil between the two shells of the cap, and then with a screwdriver or knife pry on the rolled edge of the outer shell a little until the inner shell will turn inside it. When this has been done, drill a hole through both shells to take a thumbtack or small wire. To remove or replace the cap, turn the outer shell so that the holes align, and insert the tack so that the inner shell will move when the outer one is turned. When the cap is in place, remove the tack and turn the cap so that the holes are not together,

-Adolph F. Lonk, Chicago.

Oil or Fuel Tank on Motorcycle Removed without Draining



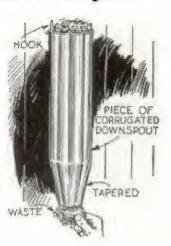
It is unnecessary to drain the oil or fuel tank when you have to remove it from a motorcycle. Just take off the oil or fuel line at the tank, and quickly slip a steel ball of

the proper size into the outlet. A union nut driven down over the ball will hold it in place so none of the liquid can escape.

-Ivan J. Stretten, Detroit, Mich.

Waste Is Dispensed in Garage with Length of Downspout

Suspended in a convenient place in a garage or workshop, a short piece of corrugated ed eave downspout is handy for dispensing cotton waste. It is pulled out at the bottom, and, if too large a quantity is removed, it may be returned at the top.



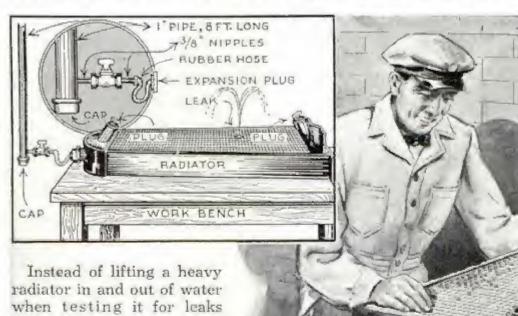
Flashlight Supported at Angle to Illuminate Wheel

When you have tire trouble on the road at night and there is no device at hand to hold your flashlight at the proper angle, prop it against the can of tube patches or other article of similar size. A rubber band around the light and can will hold the assembly together.

-G. E. Hendrickson, Argyle, Wis.



Water Column in Pipe Tests Leaky Radiator



Instead of lifting a heavy radiator in and out of water when testing it for leaks with air pressure, a mechanic saves this work by using a column of water in a 1-in. pipe to produce the pressure. This enables him to place a radiator on a bench, locate the leak and solder it without moving the

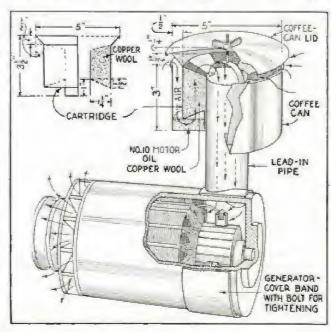
radiator. The inlet, outlet and overflow of the radiator must be plugged. If water interferes while soldering, it can be removed by taking out one of the plugs. Use of an expansion plug for the filler hole will permit quick attachment to various radiators. Water in an 8-ft. length of 1-in. pipe set

vertically will produce a pressure of about 3½ lbs., which is enough to locate most leaks. It is necessary to refill the pipe after each test to maintain the pressure.

Air Cleaner on Car Generator Keeps Dust Out of Windings

After experiencing trouble with my aircooled generator by dust being sucked into the windings and bearings, I rigged up this air cleaner. Two tin cans were used for the bowl or cleaner part, one to fit inside the other with a 1/2-in. clearance all around, including the bottom, which was cut and bent upward as indicated. A leadin pipe or tube extends through the bottom of the larger can to within ½ in. of the top. The other end of the pipe is soldered over a hole cut in the generator-cover band. Space between the tube and inner can is filled with copper wool, and the bottom of the lower can is covered with thin oil. The lid from the large can, assembled as shown, serves as a top for the cleaner.

-V. Caranci, Colorado Springs, Colo.



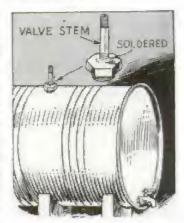
Paper on New Tire Removed with Rotary Knife



One service-station operator who mounts many tires devised a rotary cutter to remove the paper wrapping. It consists of a steel disk ½ in. in diameter fitted with a handle as shown. In use the sharp edge is forced through the wrapping directly over the tire beads and then pulled or pushed around the tire. The rounded bevel on each side of the cutting edge forms a guide to keep the knife edge between the beads.

Tire Valve Used as Air Intake for Oil Barrel

To avoid opening the screw cap whenever gasoline or kerosene is removed from a barrel, a tire valve can be used. To install it, drill a hole in the cap large enough to hold the bottom of the valve, and seal with solder. The



valve allows air to come into the tank when contents are drained out, but prevents any gases from escaping.

"Skipper"-Low-Cost, 14-ft. Outboard Runabout



Other Boats You Can Build

"Roamer"-765 to 770: Outboard cabin cruiser; two berths. Six prints \$1.00.

"Sea Saucer"—893: 9½-ft. sail boat. Deck, bottom and sides are 3/16-in. plywood. 25c.

12-Ft, Utility Rowboat-707: Flat bottom. Four seats. Sturdy design. 25c.

16-Ft, Canoe—811 and 812: Cedar planking covered with canvas. Two prints 50c.

"Arrowhead" Sloop-944 to 951: Fast sailboat 21 ft. long, 5 ft. 11 in. beam. Set of 8 prints \$1.50.

At an expenditure of only \$30 to \$40 you can build this trim, five-passenger runabout, which is powered by a 4 to 24-hp. outboard motor. Its speed ranges from 9 to 24 m.p.h. depending on the size motor used. The boat has a 54-in. beam, 15½-in. freeboard, 24-in. depth, a 5-in. draft at 725 lbs., and a weight of about 275 lbs. Six plans (Nos. 1018 to 1023 incl.) showing details of building besides sheets giving material list and outline of procedure will be sent postpaid on receipt of \$1.

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The Chemist Spins a New Yarn

(Continued from page 383)

anything in nature. It can be formed into fibers, sheets, bristles and other forms. Thousands of different nylons are possible, since many different chemical intermediates can be used. One type which appears promising for textile yarns can be made from a dibasic acid derived from phenol and a diamine also derived from phenol with the aid of ammonia. Since oxygen from the air is needed in making the dibasic acid, phenol comes from bituminous coal, and ammonia used in making the diamine is produced synthetically by uniting hydrogen from water with nitrogen from air, it follows that your nylon stockings may have originated in a coal mine, the air, and the river. Other types may call for raw materials from the farm as well as the mine. But between the mine or farm and the dress counter lie intricate chemical processes requiring elaborate equipment and rigid control.

One of the odd traits of nylon fiber is the orderly behavior of its molecules. When the fibers are first spun, their long, chainlike molecules are tossed together helterskelter like straws in a stack. But draw the fiber out to several times its original length and the molecules line up parallel and close together. What this means to the hosiery maker is that cold-drawn nylon fibers become extremely strong and elastic. Stretch the fiber to double its original length and it will keep that length; but at a certain point, say four to seven times its original length-depending upon the particular type of nylon—the fiber becomes truly elastic: stretch it further and it always springs back to this point. For example, take a ten-inch bit of undrawn fiber of a certain type and pull it out to forty inches; at any point up to forty inches it will hold the length to which it has been stretched. But stretch it to forty-four inches and it always will spring back to forty, or very near forty-for no solid material is perfectly elastic. Stretched for days, "oriented" nylon fiber will not lose true elasticity.

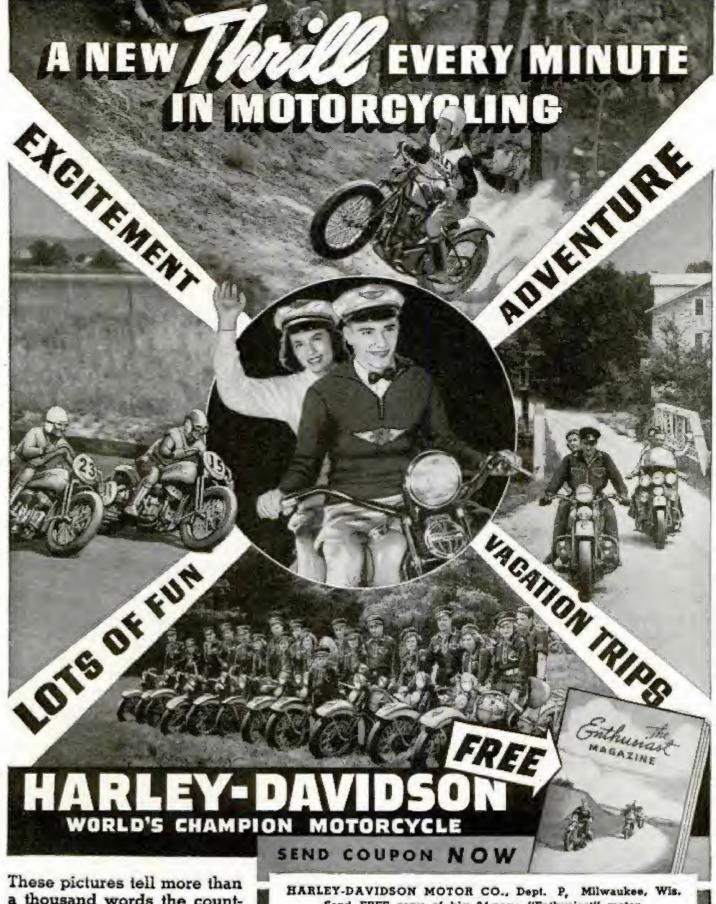
Nylon is the first fiber to surpass silk in the strength and elasticity needed for fine hosiery. Bristles made from large, colddrawn nylon filaments wear several times longer than natural pig bristles and resist the chemicals and grease destructive to brushes in bottle washing and similar industrial operations. Nylon bristles can be manufactured to any gauge, from soft complexion brushes to tough scrub brushes. They absorb little water and do not split like pig bristles.

Another valuable characteristic is nylon's habit of "setting" when treated with hot water or steam. Nylon fabric steamed while smooth tends to remain smooth. Nylon hosiery thus treated will keep its form despite repeated wear and washing. Clothes of nylon fabric will not blaze. Fire will melt a nylon dress; eventually the fire would consume the molten nylon but the fabric would never burst aflame.

Because it has good insulating properties and resists abrasion, experiments are being made with nylon coatings for electric wires. The wire might be coated with molten nylon, or it might be wrapped with nylon yarn. Doctors have found surgical sutures of nylon smooth, nonirritating and excellently adapted to closing wounds.

Just how nylon is manufactured is du Pont's secret. It is known, however, that nylon yarn is extruded through a spinneret much as rayon-to which it is no cousin, for rayon has a cellulose base—is spun. In the new du Pont plant, a pump forces molten nylon through the spinneret-a cup with as many tiny holes in the bottom as there are to be individual filaments in the finished yarn. As the molten filaments reach the cool air they "freeze" into solid filaments. The size of the filaments is determined by the rate of pumping and the rate at which the yarn is drawn away from the spinneret. If the yarn is to be drawn to four times its original length to reach the point of true elasticity, this can be done by winding it on one spool four times as fast as it is unwound from the last spool. This achieves a four-fold stretch. In other ways, some of them quite complex, nylon will be given an infinite variety of forms to serve an infinite variety of purposes.

So an infant industry that promises to become a giant was born out of the keen observation by a research chemist, not looking for textile filaments but "playing" with big and little molecules, that a bit of molten superpolymer could be stretched out like a silken fiber.



a thousand words the countless thrills and pleasures of motorcycling. See your Harley-Davidson dealer. Get the complete story of this great sport-right in the saddle of a new 1940 model!

Send FREE copy of big 24-page "Enthusiast" motor-cycling magazine filled with pictures and stories of thrilling motorcycle doings. Also literature on new 1940 Harley-Davidsons. Stamp is enclosed for mailing cost.

POPULAR MECHANICS ADVERTISING SECTION

116AF

Ocean Currents Forecast the Weather

(Continued from page 410)

agencies such as the winds, tides and changes in atmospheric pressure. Other currents and the configuration of the coasts also play their parts. In a deep cross-section of water we are apt to find a number of currents moving one below the next in varying directions, with possibly a warm saline current below a cold and less saline one. The ocean is in a continual state of unbalance and before we can understand its dynamics we must learn more about the details of its operation."

The scientists are investigating a brand new field that they have termed micro-oceanography, an examination in detail of the maze of small bodies of water that make up a major current. There are a lot of queer things about the physical ocean, one of which is the fact that although the water is salty its salinity varies at different times and places. Sea level is usually regarded as the permanent point of zero elevation and yet sea level, entirely aside from tidal fluctuations, may vary within a range of a foot a year. This may be caused by wind or by atmospheric pressure.

A surface current produced by wind moves at a forty-five-degree angle to the wind because of the rotation of the earth and yet at increasing depths this flow swings around until finally it is moving in a direction opposite to that of the wind that produced it. A north wind that parallels a west coast in the northern hemisphere moves the surface water out to sea, causing the upwelling of cold water from the depths. Some of this cold water may have left high latitudes hundreds of years ago and may have a higher than usual salinity content because it contains salt excluded by freezing of ice in high latitudes.

There are no whirlpools in the ocean such as are described in mythology but there are many giant eddies, fifteen to 150 miles across. Some of these are located permanently off certain coastal areas and others travel with the general flow of water at sea. Such an eddy current may have a speed of half a knot and along half of its circumference its direction is opposite to that of the main current that surrounds it.

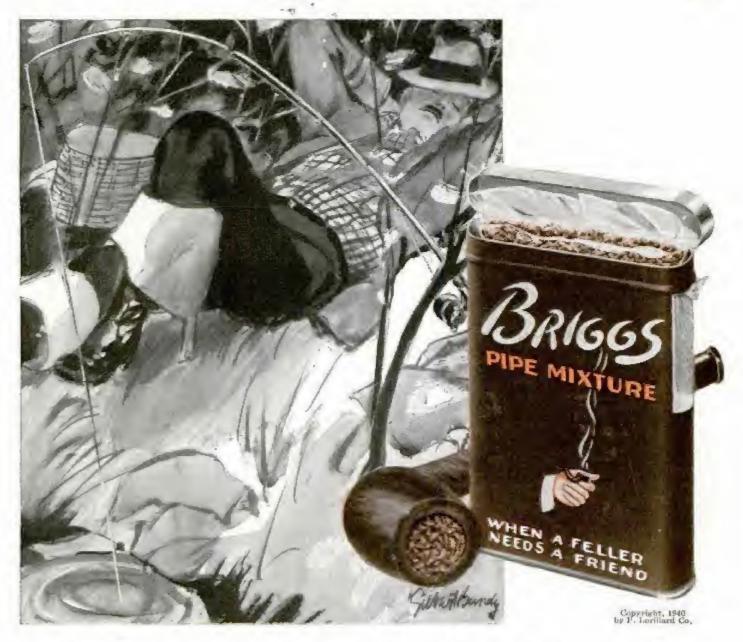
This spring and summer the Scripps' survey vessel is to cruise back and forth off southern California, making complete records of the water temperature, salinity,

density, biological life and direction and velocity of the currents at various depths at a large number of stations, and then repeating the same thing over and over again. What the investigators hope to do is to cover the same area so frequently that they will be able to follow the movement of each individual body of water that differs physically from the water surrounding it and observe whether such a body dissipates in the general mass of water or whether it retains its density, and what happens to it during its passage through the selected area.

For some of the work they will use a new type of sensitive current meter that consists of a small propeller that turns a short shaft through which has been bored a hole. A beam of light passes through the hole at each half revolution of the propeller and operates a photoelectric cell counter on the other side of the shaft. A temperaturerecording instrument that will be used for measuring vertical distribution of temperature in the ocean consists of a long, brass wire mounted in a framework insensitive to temperature changes. Lengthening or shortening of the brass wire, caused by temperature change, will be recorded on a drum turned by a vertical propeller that spins while the instrument is descending.

Studying the small flows of a main ocean current is difficult because the scientists may be confused by records of subsurface waves that have no relationship with surface waves and that have amplitudes of up to 100 or 150 feet. These giant invisible waves are created by friction at the boundaries of different currents. Other subsurface waves may be created by tidal forces. Other kinds of periodic oscillating motions at different depths will be found that may or may not be associated with the net transport of water in an ocean current, and in all of these cases the investigators will have to decide which movements that they observe are really pertinent to their work.

Aside from weather prediction, one hope of the oceanographers is that their studies of currents will help them to predict the scarcity or abundance of commercial fish. Spawning and the growth of young fish are dependent on food conditions and the amount of food available seems to depend on current movements.



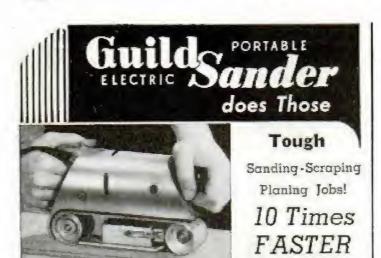
Who says laziness doesn't pay?

Years of sleeping in shaded oaken casks gives Briggs Tobacco its matchless mellowness

You can't improve on Father Time when it comes to nursing smoothness, mellowness, and bouquet into a vintage wine or a fine tobacco. That's why every pound of leaf selected for Briggs Tobacco—

and only the blue-ribbon best is chosen—is tucked away in oaken casks to slumber in the shade of the mellowing sheds season after season, while Nature works a wondrous alchemy. Harshness and tongue-bite steal away. Each golden leaf takes on mellowness, smoothness, flavor. Lazy aging—for months longer than lots of brands at twice its price—gives Briggs five-dollar-a-pound flavor, at 15¢ a tin. Try Briggs today. Meet the "friend a feller needs".





You're SURE to get an "expert" finish!

Whether it's wood, metal, stone or plastics . . . whether it's a flat or curved surface . . . whether you want to sand, grind, polish, buff, remove paint or varnish, or sharpen tools—let GUILDSANDER help you! It's light-weight, easily portable—yet it's solidly made by sanding machine experts!

Even an inexperienced user is sure to get a clean, smooth, "expert" finish, because the high speed endless abrasive belt leaves no swirls, no scratches!

to do MANY tedious, difficult, disagreeable jobs 10 TIMES FASTER—and a hundred times easier—than can be done by hand! Try out GUILDSANDER for yourself—or write direct for price and full information, also names of nearest dealer.

SYRACUSE GUILDTOOL COMPANY 1740-3c No. Salina St. Syracuse, New York

10 NEW SETS OF STANLEY PLANS

Each set includes five interesting things to make. Complete instructions.

Set No.	1	Hanging Shelves 10c
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	-	and Desk Articles 10c
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Select the sets you want; send check, money order or stamps to

STANLEY TOOLS

DIVISION OF THE STANLEY WORKS 123 Elm Street, New Britain, Conn.



Bug Hunters Wage War on Insects

(Continued from page 372)

known in both Europe and Africa, but not as a virulent pest. No information had come regarding it from South or Central America, nor from Australia.

With this evidence, meager as it is, and a map of trade routes, scientists can go almost invariably to the undesirable alien's home. The finger of science indicates a spot where trade routes of Africa, Europe, and western America cross—Australia. There a searching party is sent. The task is not simple. Often hundreds of square miles must be covered. Paradoxically, the insect pest is seldom numerous in its native land, for its enemies have kept it in check. So jungles have to be crossed, wild beasts have to be braved, fevers endured, while the very grass is examined in hopes of finding the creature.

You hear little of this side of the story, for these men are scientists, and however hard their task, they consider it only incidental. It is only after much wheedling that you can learn of the way one party, deep in Africa, encountered a herd of stampeding elephants, or the night a lion crept into camp, burned itself on a car radiator, and proceeded to wreck everything in sight before a bullet shattered its brain.

It's the bugs that are important, you see, the little creatures and their parasites those all-important parasites—which have to be brought home so carefully.

Once home, the rest is easy. There all facilities for raising bugs to full maturity exist. The bugs go through the first stages of quarantine and if they develop no diseases or personal parasites, they are liberated into a sunroom, approached by a long, black corridor, illuminated by one overhead light. Upon opening a door, this light goes out. Bugs seek the light, so they stay in the brilliant sunroom, surrounded on three sides by glass, rather than escaping into the dark corridor. Here they are raised through one or two generations, and then several hundred are gathered for further experimentation. They are taken to a private room, and placed in cages containing varieties of food. In another room, the same food may be in cages, but a different temperature is maintained. In another, the same food, but a different humidity. These tests go on until it can be determined the conditions best suited for mass production.



Would you, too, like to own a business where it is possible to take in as much as \$200 your first week as did L. A. Eagles in his new business?

We want a reputable, honest man in each county. This man need not have any special experience or more than ordinary ability, but he must be honest and courteous.

Such a man we will start in business for himself. You can make far above average profits in the rug-washing business—a high-grade business all your own. Many earn \$125 to \$200 per week—some considerably more.

NO SHOP NECESSARY

The rug-washer cleans rugs like new on the customer's floor. Anyone can run it. Electricity does the work. A quick, thorough and highly-efficient method that brings out the natural beauty of floor coverings.

There are hundreds of customers—in your vicinity and nearby towns. The business grows steadily. Simply wash a few rugs or carpets. These customers tell others and also give you their future work. Soon you will have a prosperous year-around business. Send coupon for booklet application appropriation of the coupon for booklet. explaining everything.

"Profits Pay for Home"

Harry Hill built and paid for a home from rug-washer profits. His first day's business was \$86. Another man writes, "Made \$70 in 13 hours." A. L. Miller says, "Have had rug-washer 6 years—have earned as high as \$92 a day." M. O. Malmin carned 3 times the cost of his machine the first

two months. You, too, can enjoy a large income.

VON SCHRADER MFG. CO., 103 PL., RACINE, WIS.



MAIL COUPON NOW!

VON SCHRADER MFG. CO. 103 Pl., Racine, Wis.

Send at once (no obligation) your free booklet illustrating rug-washer and telling how I can own my own permanent business; how I can earn large profits at prices below other methods; how I can become financially independent in a short time: and how I can pay on easy terms.

I City State

"Never a Complaint"

C. J. White says: "\$100 business in six days— never a complaint." That is the nicest part of this business—every customer is more than satis-fied. Stains and blotches disappear and vivid colorings and freshness in faded floor coverings come back,

EVERY MACHINE GUARANTEED

You take no risk. These machines have been manufactured since 1918 and are used by the United States Government and by many of the world's largest hotels. They are fully GUARAN-TEED.

EASY TERMS

The complete equipment is inexpensive. reasonable down payment brings everything to you and the balance is paid monthly. From the start, you have your own business—one that is profitable and of which





and Power Lawnmower A Practical Power Plow and Cultivator for Gardeners, Suburbanites, Florists,

Truckers, Nurserymen, Fruit Growers -Low Prices - Easy Terms American Farm Machine Co. 1058 33rd Av. SE. Minneapolis, Minn.





with all the trade you can attend to? Then become a foot correctionist, and in a few weeks earn big income in service fees, -not medical

-casy terms for home training, no further capital needed, no goods to buy, no agency. Established 1894. Address

Stephenson Laboratory, 1 Back Bay, Boston, Mass.

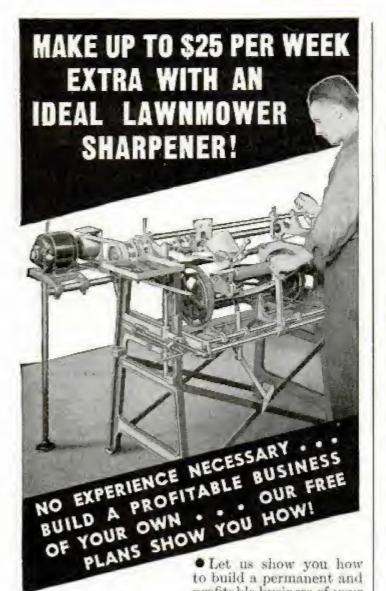
To Plate Auto Parts

Reflectors, Bicycles, Fixtures, Mirrors, by late method. Simple plan of manufacturing at home starts you IN GOOD PAYING BUSINESS. Write today for FREE particulars and proofs.

GUNMETAL CO. Ave. M

Decatur, III.





profitable business of your own—sharpening lawnmowers. Most men earn up to \$25 a week. Roy F. Stier, Wisc., writes, "I paid for my Ideal Sharpener in exactly 36 days and have to date sharpened 200 mowers at \$1.25 each. I live in a village of 500 people." Howard Hellen, Minn., writes, "I sharpened 745 lawnmowers, sold 60 used mowers and grossed \$1,000.00 from April 5 to Sept. 15." A. M. Larsen, Utah, writes, "We average 9 lawnmowers a day." Chas. H. Chism, Ohio, writes, "I have had as high as 30 mowers come into my shop in one day." P. G. Armour, Pasadena, Calif., writes, "We get \$1.00 for small 4-blade machines, \$1.25 for 5-blades, \$1.50 for large mowers."

GOOD LAWNS Require Sharp Lawnmowers . . . Cash in Now!

With the Ideal Sharpener, it takes only a few minutes to make an old dull, badly worn mower cut like new. Set the mower in the Ideal, make a few simple adjustments, and the machine does the rest. Sharpens any mower to a perfect edge in 15 to 20 minutes—usual charge \$1.00 to \$1.50. Customers come back year after year. Positively no experience necessary. Attach to light socket. Start in your basement or garage. Work in spare time only if you wish. Attachments for grinding skates, grass shears, hedge shears, sickles, scythes, and axes. FREE CAT-ALOG tells complete story.

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OF YOUR

OWN

THE FATE-ROOT-HEATH COMPANY 340 Bell St. PLYMOUTH, OHIO

make money--SHARPEN LAWNMOWERS!

Torture Chambers of Industry

(Continued from page 415)

The automobile you ride in withstands abuse on the road because it has been subjected to much greater torture than it will ever receive in service. There is the "Death Chamber," where engines are run to de-



For more than nine years these lans have run, winter and summer, rain or shine, on laboratory roof

struction. With throttle wide open, a motor roars hour after hour, until the manifold is cherry red. Finally something rebels, and the engineers hold an autopsy that will enable them to design a still better motor.

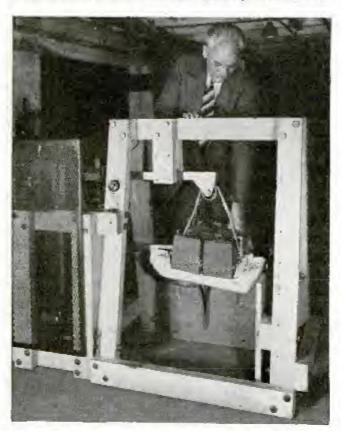
There is an underground armored pit where a flywheel spins 12,000 revolutions per minute or faster, until it bursts through centrifugal force. An automatic device intermittently pushes an automobile starter button; it takes 60,000 such starts before failure begins—the equivalent of ten starts a day for sixteen years. Springs are tested by continuous dropping of a thousandpound weight on them, then suddenly releasing it. Today's springs rebound from such a test half a million times without breaking. The front-wheel suspension parts are tortured in a machine that produces a combination of shimmy, hula, and rumba. They've reached the point where the parts tested outwear the machine.

The most brutal test of all is the "Belgian Roll." Here a car is mounted on sets of drums and chained in place. The drums, with lugs bolted to them, are revolved rapidly, pounding the tires and causing constant spring action and car movement, similar to the roughest "scrubboard" road. Ninety hours of this is the equivalent of 100,000 miles of average driving.

Will the hydraulic lines and brakes carry pressure and the whip of rough roads for the life of the car? A breakdown device whips brake hose around like a jumping rope at 850 revolutions per minute, with 250 pounds of hydraulic pressure inside the hose. Stock equipment now stands up under 150 hours of this punishmentequal to 100,000 miles of fast driving over rough roads. A torsion machine twists steel bars used for axles completely around, not once but twice—and then some -before they fracture. In the "Rocky Road to Dublin" test, weights of 155 pounds are bounced on seat cushions 1,200 times an hour, until the cushion comes apart.

In the National Bureau of Standards in Washington a massive compression-tension machine subjects specimens to 2,300,000 pounds of hydraulic pressure. Safer buildings and bridges have been made possible through hundreds of tests on this machine.

There is a dish smasher, much more effective than the newest bride, which de-



Dropping 200 pounds of metal on seat of telephone booth repeatedly until screws are torn from wall

molishes thousands of tableware samples, to develop long-lived crockery. There is a walking machine that tests the wearing quality of shoes. Shoes fitted to artificial feet mounted on the spokes of a wheel walk along a belt until they wear out.

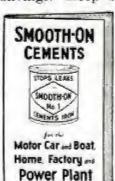


\$10[∞] SAVED per dollar spent - a fair average for SMOOTH-ON No. 1

Smooth-On No. 1 has a value far out of proportion to its ridiculously low material and application cost, and invariably pays a very high return to the householder who does his own tinkering. Home mechanics appreciate the ease of making Smooth-On repairs (without heat or special tools), the quick readiness for full-capacity service, and the reputation for competency which these repairs give to those who make them. Every one likes the speed with which a Smooth-On job gets things in good working order again after a breakdown or leak has caused annoy-

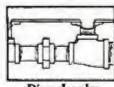
The performance of Smooth-On No. 1 has been stepped up to meet every demand in stopping a leak or tightening a loose part, and recent changes in the composition also make application easier than ever. Used judiciously, Smooth-On No. 1 can be depended upon for a repair that is perfect and permanent.

All that would be used in the home in a year usually costs less than the saving in a single simple application, and if you fail to utilize Smooth-On economies, you overlook one of the best opportunities to make household savings. Keep Smooth-On No.



Land the Smooth-On Handbook in your work-bench, The help-ful advice, instructions, and working diagrams in the booklet afford a reliable guide, based upon good engineering practice.

Get Smooth-On No. 1 in 7-oz. or 1 or 5-th, can from your hard ware store or direct from us.



Pipe Leaks

Boiler Leaks

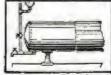
Radiator Leaks



Fire Pot Leaks



Smoke Leaks



Tank Leaks



urnace Gas Leaks

Write for

Write for FREE BOOK	SMOOTH-ON MFG, CO., Dept, 37 574 Communipaw Ave., Jersey City, N. J.
	Please send Smooth-On Repair Book
STOPS LEAKS	Name
SMOOTH-ON	Address
CEMENTS IRON	3-10
Do it wit	& SMOOTH ON

Making Money with Hens

(Continued from page 405)

matically at constant temperature and humidity; the only human attention is the turning of a crank to shift the eggs.

Before they are four days old the chicks are either shipped to battery operators or sent to the starting cages on the Arndt half acre. In these cages, three feet by six feet and twelve inches high, 200 baby chicks snuggle under an "electric mother," a wire heating element that is as comfortable as a hen. The first thing you notice in the nursery is the red windows. Daylight shining through them gives the chicks a reddish cast. You'd think it would make them see red; it does just the opposite. Cute little things, these chicks are cannibals. A bit of red comb invites an investigatory peck; a drop of blood starts a tiny riot. But in the red light from the windows, the red comb and the droplet of blood appear white and attract no attention.

After four weeks in the starting cages they move to another battery accommodating twenty birds, where the pullets stay until they're twelve weeks old and the cockerels stay about four weeks; then they're one-and-a-half to two-pound broilers, ready for market. In a third battery the pullets, twelve in a cage this time, stay from the twelfth to the twentieth week. Then they move into single-room apartments to stay as long as they pay the minimum rent, a dozen eggs a month,

Thinking the hens might appreciate music in the factory, Mr. Arndt installed radio loud speakers. As a "control" for the experiment he turned on the radio one month, left it silent the next; result, three to five per cent more eggs during the musical month. The ladies of the hen house prefer organ music, and do their very best packaging on Sunday mornings.

In the country, hens work shorter hours during the dark days of winter. In the warm battery they work a thirteen-hour day winter and summer; time clocks turn on the lights. Production stays level the year around, and you have more fresh eggs to sell when prices are highest. Mr. Arndt's latest stratagem is to turn on the lights for an hour at midnight and serve an extra snack. He believes the additional meal will step-up egg production. The hens seem perfectly willing to lose an hour's

(Continued to page 124A)

WB rs Guide



EASY TERMS The complete line of Delta low-cost wood working tools—Saws, Lathes, Drill Presses, Sanders, Sanders, Jointers, Grinders—is now available on liberal extended terms through Delta dealers,

If you are interested in power tools for your workshop-there are vital inside facts you simply must know before you can make a sound decision. These facts are now available to you in the New 1940 Delta Catalog which not only lists the complete line of Delta "Quality" power tools-but shows you the important points to

look for in all power tools. It explains the advantages of "diamond-boring" of bearing seats, "pre-loading" and correct mounting of ball bearings and "sealed-for-life" ball bearings. It illustrates many hidden features of design and construction that make for long, better service in power tools. It takes up the major power tools one by one and analyzes various types of design and shows the advantages and disadvantages of each design. It shows you the features you should look for in selecting power tools for your shop. Truly this new 1940 Delta Catalog is A BUYER'S GUIDE—crammed with useful information that every craftsman should have. Send for your Free copy today.

MANUFACTURING COMPANY

Dept. A 340 600-634 E. Vienna Ave., Milwaukee, Wis.



Universal Tractor

You plow, disc, cultivate, mow. haul, do belt work, for about 33c a day. Safe, trouble-free long life. New plow lift, new reverse. Hundreds used. Save by buying from maker. Two weeks trial, FREE catalog. Write today.

PIONEER MFG. COMPANY Dept. V-30

FREE 32 Page Catalog of World Famous "National" Electric and Amplifying Guitars.

Be Popular and Play One of These New 1940 Models

Write Today, No Obligation,

National Dobro Corporation, 484 W Peoria St., Chicago, Ill.



For 8" to 15" Metal Lathes. Build it Yourself.

At last, a precision griender within your means. You save 2/3 by finishing our semi-included catings on your own laths. RUHON handles both internal and external grinding. Accuracies to .00025. Mirror finish easily obtained. Grinds sales, pinose, bushings, abofts, hard or soft, holes, lothe enders. Bharpens reserves, milling cutters. Does excentive trillings lane; polishes; mores of other uses, for home workshops, granges, meabine shope. Write for FRES illustrated folder and full information.

on Machine & Tool Co., Dept. B-3, Yale, Mich.



. 42



Adds, subtracts and multiplies up to one billion. Weighs only 4 ounces. Not a toy-strong guarantee. Absolutely accurate, very fast. Sells to offices, stores, homes-wherever figures are used. Write quick for FREE AGENTS sample offer and Money-Making Plan.

VE-PO-AD, Dept. 205, 303 W. Menroe St., Chicago



BURN YOUR NAME ON TOOLS

PROTECT YOUR TOOLS FROM THEFT with electricity any name or design on the metal, like writing on paper with pen or penell.

Complete Outfit \$3.50 - fittald Anyabera
Interesting illustrated circular free. Write today. Agente wanted. ARKOGRAF PER CO., 3927 S.E. Stark St., Parlland, Ora.



Big Money for Workers In Home or Shop



GUARANTEED basement waterproofing. Color-glased concrete, gravestones, tiles, walls, floors. Lawn, cemetery pottery. New method. Use only sand, cement, cheap materials, Operators wanted, Full or part time. No skill required. Big carnings, Booklet, details 5c (stamps or coin).

NATIONAL POTTERIES COMPANY 13 W. 26th St. Minneapolis, Minn.

in 9 Months



MOWER SHARPENER LAWN

"A substantial increase in grind jobs each year, proves beyond any doubt that Foley Grinders do very satisfactory work. We have ground 723 mowers since February 1 to date, November 9. Our total receipts on lawn mower service alone during that period has grossed us \$1,025.00. The prevailing price of grinding and adjusting service is \$1.00 and \$1.25—repairs and parts extra."—W. A. Tulip, Phoenix, Ariz,

You Too Can Make Big Money

Free plan tells you how to start. The Foley Lawn Mower Sharpener turns out perfect work quickly and easily, no experience needed. Simply put the mower in the markine and turn on the power. Uses same system as lawn mower factories. Sharpens all sizes and types in 10 or 20 minutes.

Special Offer: Attachment for grinding axes, hatchets, knives, etc., included FRRE with Foley Laws Mover Sharpeser on our Special Offer, brings you business the year around. Bend coupon today.

FOLEY MFG. CO. 307-40 Foley Bldg., Minnespolis, Minn.

Send Free Plan for making money sharpening lawn mowers, and Special Offer on the Foley Lawn Mower Sharpener.

Address......



 THE rustle of leaves in a whispering breeze, with the light of a moon for your mood. An Old Town Canoe is a world of your own . . . your passage to peace and contentment.

The dip, dip, dip of a Redskin's paddle takes you through quiet enchantment. Paddling or resting, it's steady and strong. It's sturdy and easy to own.

FREE CATALOG shows all kinds of Canoes for paddling, sailing or outboards. Also Outboard Boats, including big all-wood family boats. Rowboats. Dinghtes. Write today. Address Old Town Canoe Company, 633 Main Street, Old Town, Maine.









Metal Products Co. 5 Commercial St. Rochester, N. Y.

(Continued from page 122A)

sleep if they can spend it eating. It's like a midnight raid on the icebox.

Like any business, the egg factory has its problems. You have to sell the eggs. You're better off near a big-city market. You make more by selling at retail to neighbors, or at a roadside egg counter. The large-scale battery can make wholesale contracts with big users: hotels, bakeries and ice-cream manufacturers. Some day industrial chemistry will find new uses for eggs, too. Here's an odd one: rotten eggs, the yolk of fertilized eggs which fail to hatch, are used to tan kid gloves.

To give you an idea of costs and profits, here are Mr. Arndt's figures on a year's operation of a 1,296-hen battery. The original investment comprises a fifty by 100foot lot, figured at \$62.50; the building, with hot-water heat, ventilation and light, \$2,500; 1,296 cages, \$1,879.20; 1,296 readyto-lay pullets, \$1,944—a total of \$6,385.70.

The year's estimated expenditures he lists as eighty pounds of feed per bird, or fifty-two tons at \$50 a ton, totaling \$2,600; replacement of culled hens at four per cent per month or 622 pullets a year, \$933; depreciation allowance on building and equipment, \$312.92; reserve for repairs, \$100; insurance and taxes, \$150; fuel, water, light and power, \$125; egg packaging, \$170; total \$4,390.92. If you hire help, a trained man gets \$1,200 a year.

Total estimated income, \$7,760, includes \$7,257.60 from 20,736 dozen eggs at thirtyfive cents a dozen; cull hens sold as table fowl, \$372.80; from 1,300 bushels of manure at ten cents a bushel, \$130.

This means an operating profit of \$3,369.48 if you do the work, or \$2,169.48 if you hire a man. The latter figure represents over thirty-three per cent return on the original investment of \$6,385.70.

Maybe 1,296 hens sound like a big flock for a garage mechanic or teacher or bank teller or his wife to take over without a nickel's worth of experience. Well, you could start with only forty; on the other hand, one man can manage 3,000 layers.

Costs and sales prices vary around the country. But a lot of folks with a half acre like Mr. Arndt's or a back yard like your own are discovering that if hens don't lay golden eggs, they do manufacture a steady supply of fresh eggs, neatly packaged and as good as gold.

Bull Run Up-to-Date

(Continued from page 379)

hence could advance unharmed against rifle and machine-gun fire.

This tremendous power of modern weapons to kill is what makes today's battlefield apparently devoid of life. The whine of machine-gun bullets, the nerve-shattering crash of high explosive, have so driven the present-day soldier to cover that his opponent catches only fleeting glimpses of him. Only fragmentary bits of battle flash before the observer.

The greatest contrast between the battles of 1862 and 1939 was the matter of mobility. It took General McDowell two full days to march his federal army from Washington to Centerville, only twenty



Thirty-seven millimeter gun being moved into position by infantrymen during maneuvers

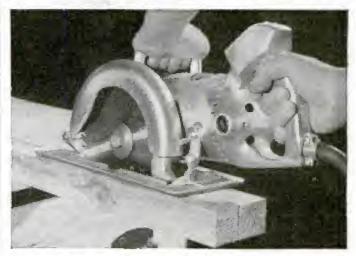
miles away. Two hours was all the motorized regular division needed to move that distance in the 1939 maneuvers.

One fact revealed by the Bull Run of 1939 is that the regular army, which is supposed to be ready for action on the day of mobilization, is not ready now. Its ranks are below peace strength, less than half of war strength. It is deficient in all types of modern weapons.

The National Guard suffers from these same defects but in a much greater degree. Though mobilization plans call for the guard to take the field thirty days after mobilization, General Drum, commanding the first army, estimates that from six months to a year of intensive training would be needed before the units are ready for battle.

¶Inquiries as to makers of articles described in Popular Mechanics will be answered by our Bureau of Information upon receipt of return postage.

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The Hornets of the Air Corps

(Continued from page 389)

ciency and safety and only those who react rapidly and have a special aptitude for the kind of flying they do are selected for the advanced training that is necessary. The flight training program is slow and positive, gradually bringing the pilot down to minimum altitudes after he has demonstrated his ability at higher levels. Once judged competent, pilots are trained continuously in attack work so that they won't lose the knack of safe flight close to the ground.

Just as exacting is the training that the enlisted gunner receives. The sensation of facing aft in the rear cockpit while maneuvering close to the ground is sometimes similar to the reaction you would get by riding backward on a roller coaster. If he faces forward the gunner can operate a second set of controls to fly the plane if the pilot is disabled, and he is connected with the forward cockpit by means of an :interphone and a signal-light system. It is difficult to judge distances in aiming at an airplane diving toward his plane from the sky, and part of the gunner's training is practice with a photo-gun that reveals his degree of marksmanship.

Night missions are the most difficult. Squadron leaders are expected to lead their planes direct to the objective even though check points by which they navigate are lost in the night haze. In fog or clouds the formations bunch up until the navigation lights of the wing pilots shine in the cockpit of the leading plane. Over enemy country and racing downward toward the objective the formations tighten up again to prevent the noise of the motors from spreading over too wide a range and to minimize the chances of being heard by the anti-aircraft listening network. Every pilot switches off his navigation lights and keeps track of the other planes by their shadowy outlines and from what exhaust glow he can see.

The powerful motors of the attack planes are designed especially for low-level operation, just the opposite of the supercharged engines that carry other airplanes to tremendous altitudes. Efficient as present planes and motors are, larger and faster attack planes are to be put in service by the Army Air Corps to make the work of the attack groups even more effective.

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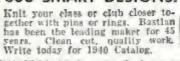
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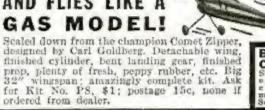
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The Glass Age
(Continued from Coloroto Section)

doors into the home, so the glaziers have popularized the picture window for "framing" a beautiful view of a garden, a lake, or some other vista near the home.

A flesh-tinted plate glass that creates a feeling of warmth in a room during the winter months is another innovation. So is a plate windowpane, sea green in color, designed for rooms getting too much sun. Heat is absorbed by this glass but there is no interference with the transmission of visible light. Thus, while admitting seventy to seventy-five per cent of the sun's total light, the glazing material transmits less than forty-three per cent of the total solar heat.

Murals of glass are a new ally of the decorator. A Chicago restaurant has a series of these panels, thin, opaque glass and tinted mirror pieces being used to carry out designs on a jade background. Mirrored murals in plate glass with edgelighted figures in sandblast design are coming into favor also.

Colored mirrors have been found to be helpful in giving a room an air of spaciousness. They likewise serve as a magnet of trade for shops. Why? Well, people like to look at themselves and colored mirrors provide a variety of effects. A pink mirror makes persons look sunburned and healthy, a green one gives them an air of mystery, blue is flattering.

Of course, colored glass is not new but until recent years it could not be made except with a rippled surface. The modern system of making flat colored glass is that of laying the material out on slate slabs and heating underneath by steam pipes so the silvering solution, poured on cold, is precipitated on glass. Two coats of this preparation and the mirrors are shellacked, then painted. In place of shellac, copper is electroplated on mirrors that are to be used outdoors or in bathrooms where there's a lot of moisture.

In olden times, a glass blower would heat a lump of glass to a plastic state, and then his helper, seizing one corner with a pair of tongs, would race away with it. The most advanced system of making fiber glass is that of feeding glass marbles into a small electrically heated furnace. By gravity, the molten glass flows through a row of fine holes in a precious metal die, coming out as fibers. To make the fibers extra fine-those used in spinning are about one-fifteenth the size of the average human hair—the hot, pliable strands are stretched to produce continuous filament fiber by being wound on a rapidly rotating drum or else they are pulled out in a quickly descending column of steam that breaks up the fiber into short lengths. The coarser fibers are being utilized extensively in thermal insulation and acoustical treatments. Because of its flexibility and strength, a bright future is being planned for this type of fiber glass as an insulator for electrical apparatus.

The continuous filament fibers usually are spun directly into thread and may then be woven or braided by cotton machinery that's been adapted for this work. Glass textiles and fabrics can be produced in a variety of colors and, being fireproof, furnish a maximum of safety as well as beauty in theater curtains, draperies, and awnings.

Sand silica has been the base in all glass but by substituting a number of rare chemicals for it, an optical glass promising superior and "faster" camera lenses has been developed.

Photographers are likely to get another break as soon as the revolutionary coating, which makes glass both non-reflecting and invisible, is applied to lenses. Purest glass transmits about ninety-two per cent of light, whereas ninety-nine per cent would be possible with coated glass. In other words, a camera lens ordinarily cuts out eight per cent of the light; on a better type camera with three or four lenses, fully thirty-five per cent of the light never reaches the plate. All but a small portion of this light would be saved by the "invistible glass" announced several months ago by Katherine Blodgett.

And what of the substitutes for glass? At present, only one gives promise of being a threat to glass' supremacy. It's the thermoplastic resin that is known in this country as Lucite. In addition to being virtually unbreakable and much lighter than glass, polymerized methyl methacrylate, as the substance is known technically, can be sawed, cut, drilled and polished. Like quartz, it has edge-lighting facilities, transmitting light around a bend without lighting up the sides.

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100.000-Mile Tires

(Continued from page 335)

speeds of fifty to sixty miles per hour, subjected to the grueling strains and stresses of constant flexing, the inside of an ordinary truck tire gets sizzling hot. The terrific internal heat generated, often as high as 300 degrees Fahrenheit, causes cords in the fabric to lose a large percentage of their tensile strength, to literally burn out, to deteriorate, and the rubber to crack. Tire growth is caused by the stretching of cords weakened by heat. As the tire swells, more tension is put on the rubber compound, causing it to generate additional heat-to age and deteriorate. Thus, the whole tire becomes fatigued, the prelude to a blowout, as cracking and separation of the tread develop.

Heat-resistant cords, during manufacture, are treated to soften the natural gums and waxes inherent in cotton fiber. While softened they are compressed, the gums and waxes allowed to set, forming an excellent bond of the fibers. This prevents slippage of fibers, utilizing all of the steellike strength of the fibers. Under strain and flexing in the tires, the fibers do not rub together to produce as high heat as do some other cords. Heat that is generated cannot get down into the cord to cause charring and disintegration. Although the finished product is smaller, it is said to be stronger than larger ordinary cords made by twisting and cabling. Tensile strength about one-fourth greater than that of ordinary cords is claimed, plus the ability to maintain strength, stamina and safety factors under the severe operating conditions of truck and bus service.

Grueling tests in Death Valley, with temperatures exceeding 100 degrees, have revealed that the heat-resistant cord is superior to many other cords. During these tests, ninety different cord fabrics were subjected to "murder runs" on the wheels of overloaded trucks running at high speed, hour after hour. Cords burned out, flex breaks occurred and one after another of the tires failed. Under identical conditions, heat-resistant cord tires averaged 40,000 miles on the original tread, were retreaded and run 30,000 miles more, then given a second new tread and operated beyond the 100,000-mile mark.

Many tires in regular service on a truck line running between Chicago, Ill., and

Waco, Tex., are giving over 100,000 miles of service without recapping or retreading. From Chicago to the Texas border, the trucks are loaded with 18,000 to 20,000 pounds. There part of the loads is removed, because of load-limiting laws, and the run continued. Estimated speed of the trucks averages fifty miles per hour while the tires are in service, and the average mileage for all tires on this run is well over 80,000 miles per tire.

In the laboratories, the new heat-resistant cord has been subjected to tests more severe than ever before used. After the cord has been baked in an oven at a temperature of 300 degrees Fahrenheit, samples are removed regularly at fifteenminute intervals over a period of thirtysix hours and subjected to a "torture" machine which determines how much of its tensile strength and other desired properties may have been lost in the oven.

Also, from time to time, tires made of the new cord are taken from stock and placed on another torture machine, a testing wheel. The temperature in the room remains at 100 degrees and the tire runs at terrific speed day after day until it blows out. The tire is heavily loaded and runs against a smaller pulley which gives it a great deal more flexing than the tire would receive in actual service. During the test, the temperature of the tire is taken at regular intervals with a pyrometer, a needletype thermometer.

Heat-resistant cord is being introduced to the passenger-car field where the serv ice is not so severe but where safety is all important.

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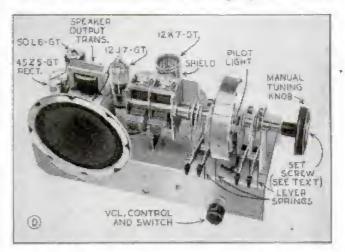
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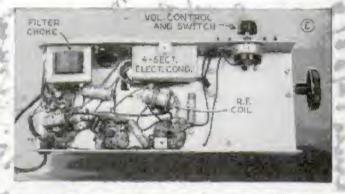
(Continued from page 457)

shows a detailed sketch of the cabinet used to house the model; it can be built in the average woodworking shop, or, similar size blank front cabinets can be obtained from parts houses.

A simplified wiring diagram appears in Fig. 3. Readers who have built former models will note that the same types of antenna and r.f. coils are employed. When



mounting the various parts, refer to photos A, B, C, D and E which show various views of the completed instrument. Please note that the 2-gang variable condenser mounting bracket is fastened to the upright bracket that supports the push-button tuning unit assembly so that the bottom of the condenser unit will be just 1½ in above the base. A sheet-metal shield 1½ in. long and 1 in. wide is soldered under the center partition that divides the two condenser sections. This shield should



clear the top of the base by about % of an inch. Use No. 18 hookup wire with pushback insulation, and rosin-core solder for all soldered connections.

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(Continued to page 134A)





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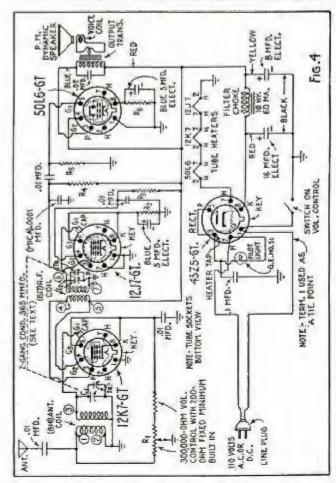
CHICAGO WHEEL & MFG. CO. 108 S. Aberdeen St. Chicago, Illinois

sands,

(Continued from page 132A)

2-gang 365-mmfd, variable condenser is a counter-clockwise type. The "Crowe"type tuning mechanism and escutcheon comes with mounting brackets and broadcast station labels. A detailed list of the original materials used, is available from Popular Mechanics Magazine radio department without charge. All parts are easily available and inexpensive, but must be as specified for maximum results.

If operating on a d.c. line supply, it may be necessary to reverse plug in wall socket



to obtain correct polarity. Reversing plug in a.c. line supply will also often eliminate line hum. To balance the set, turn variable condenser about seven-eighths open and adjust the two trimmers (Tr) with a small screwdriver, for maximum noise. Now, set up the four stations for push-button tuning in their frequency order. Loosen the screw in the center of tuning knob; tune to desired station with knob, and, while holding knob firmly, push down that station button as far as it will go. Repeat this process for the other three station buttons. When all four station buttons have been adjusted, hold the tuning knob firmly and tighten screw in center of knob. The blueprint number for this article is R-276.

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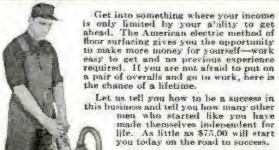


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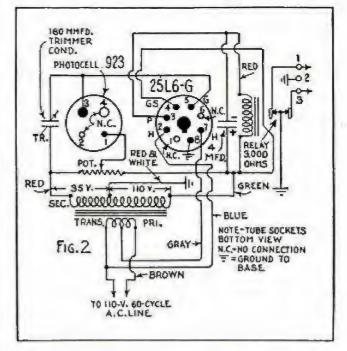
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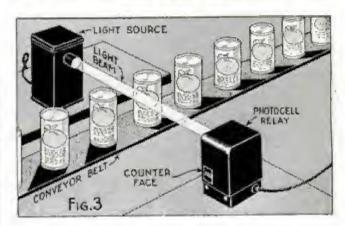
Photocell-Operated Relay

(Continued from page 458)

cord in 110-volt a.c. outlet and allow unit to heat for several minutes. Now adjust trimmer condenser (Tr) until meter shows approximately two-tenths of a milliampere. Next remove cover from photocell, and, with a moderate light falling on cell,



advance potentiometer until the relay closes. Place cover over cell again and the relay should fall out. Recheck meter current and if necessary readjust (Tr) to get two-tenths m.a. Remove meter from the circuit and solder the ground lead back on pin No. 8. The unit is now ready for oper-



ation. Never advance the potentiometer further than necessary to close the relay.

The light source illustrated in Fig. 3 and the sketch at the head of the article, is merely a 40 or 60-watt mazda lamp housed in a sheet-metal container 4 by 4 by 7 in., fitted with a short tube and lens.

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School Days for Elephants

(Continued from page 363)

ply went through the routine a dozen times in the morning and again in the afternoon until it learned to go and to stop on command. Now came the hard part: letting it see a tiger in the same cage with it.

The moment the delivery door clicked, letting the big Bengal into the circular cage, the elephant whirled to face it and let go with a blast that sounded like the trumpet of doom. Several of us were bruised from being pushed against the bars and into heavy pedestals before we succeeded in quieting the elephant by driving the tiger out into the delivery runs.

Several difficult days went past before the elephant could learn to tolerate the tiger and to stand still while the big cat entered the arena, mounted a pedestal and ran out again. This much was running true to form in acts of this kind; it was harder to teach the mount than to teach the cat.

This simple routine went along for more than a week. Then we put a blind on one side of the elephant and had the tiger mount the platform on the elephant's back. We had a busy time of it before the elephant settled down to a steady jog and began to respond to our commands.

In about ten days they were working so well together that we speeded up the routine which, on more than one occasion, caused the tiger to miss its timing and fall off, running either under the elephant or between its feet, yet neither gave us any undue trouble.

At last the lion was added to the act and taught to ride beside the Bengal and there was plenty of fighting between these two. The elephant, by this time, was so tractable that it paid little attention to the natural antipathy which the riders had toward each other, and the act was ready for presentation in six weeks.

An interesting trick performed occasionally by elephants is plank walking. We start with a wide plank about twenty-three inches off the ground and decrease the width of the plank gradually until it is no more than six inches wide. This trick can be taught in two weeks if the elephant is accustomed to tricks that involve balancing its own weight.

The most dangerous trick I know of with

(Continued to page 140A)



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(Continued from page 139A)

an elephant is the famous "Head Carry." I have never used it. Every man I know of who has done this trick has been killed or injured, usually seriously. The pressure required to carry the suspended weight of a man the length of the reserve seat section on one side of the hippodrome oval is about half the pound pressure of his own weight. Which means that a man weighing 150 pounds has seventy-five pounds of pressure on his skull. Even by using the helmet, the head gets out of shape after a time and cauliflower ears are inevitable.

Circuses find elephants valuable not only as performers in the rings, but in the actual movement of the show—putting up and taking down the nomadic city of canvas, often under weather handicaps. Thus several elephants are broken to harness, but there are rules for making harness elephants out of educated, performing elephants just as there are for making actors out of the jungle pachyderms. The most important thing is to be sure of a good fit. If an elephant man does not know how to fit a set of harness, he may cause the elephant to injure its back.

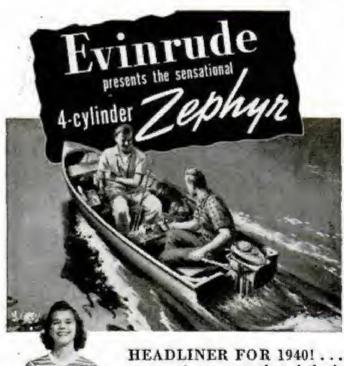
There are many ways that can be employed in teaching obedience to elephants, but I favor the practice of treating them as you would treat a child. Patience, use of the voice instead of the bull-hook, will work wonders, for when an elephant understands what is required of it, a surprising amount of intelligence is yours to command.

Rolling Up the Strikes

(Continued from page 395)

No two hands are alike; thumb and finger sizes vary as do hand spans. The most consistent bowler is one who has a ball fitted to his hand. There are three types: (1) the standard available in two and three-holed borings, which have the holes custom drilled at an angle parallel to the core center; (2) the trick grips designed for bowlers with abnormally shaped hands or peculiar delivery styles, and (3) a new grip that I've had a hand in developing that's based on a new boring principle that imparts uncanny accuracy to a hook from a natural delivery.

In order to understand the idea back of this improved grip, pick up a baseball, a



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billiard ball, or any other round object of similar size as though you were about to spin it from right to left. Notice the position of your fingers as you pick it up preparatory to spinning it to the left. That's the way your fingers fit inside the new grip ball.

With regard to the position of the fingers on the outside of the ball, it's pretty hard to lay down any hard and fast rules.

A great many bowlers think their fingers must be spread all over the ball to develop a hook. Actually, however, you can use any style of play, a straight ball, a hook, back-up, or curve, with the fingers spread or close together, just as long as the fingers feel rested in a natural position.

On delivery, a good player will take his stand twelve to fifteen feet back of the foul line, the distance varying according to your stride and whether you're using a three, four, or five-step delivery. When addressing the pins your body should be erect with shoulders square at the pins. Feet may be close together, slightly apart, or left foot slightly extended, but in any event, the weight of the body should be distributed evenly on the feet. Ball should be held somewhere between waist line and shoulders, supported by the left hand.

Here is a four-step delivery I have recommended to many bowlers with good result. Starting with the right foot, you take three steps forward at a fast walk-not a run-and a glide which brings you to the foul line in an easy swinging motion. Keep your steps evenly spaced and deliberate, and exercise only a minimum of effort on approach and delivery. The timing of your swing of the ball and the number of steps you take, as in the delivery, including the swinging of the ball and your stride, must be in perfect rhythm at all times.

Bend your knees on the final step, which is a slide, and release the ball about twelve inches above the alley bed. If you make it a point to keep back of the foul line in practice games you'll bowl better in league and tournament games. If you're a righthanded bowler wear a rubber sole on your right shoe, an elk-hide sole on the left. In this way you can break your slide with the right foot while sliding with the elk-soled one. Don't try to bowl in street shoes or crepe-soled oxfords.

For the strike ball, as the first one's (Continued to page 143A)



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POPULAR MECHANICS PRESS

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(Continued from page 141A)

called, form an imaginary line to the 1-3 pocket, to the right of the head pin between 1-3 pins, and proceed to roll the ball on that line, starting the ball from the spot you have selected at the foul line. If you have any trouble keeping the ball on the right-hand side, move in a few inches farther from the corner of the alley, or if your difficulty lies in getting the ball up to the head pin, or 1-3 pocket, you should either place the ball closer to the corner of the alley or else point it a little higher. It's been my experience most novices acquire control and delivery much faster when they bowl a straight ball from a spot six to eight inches from the right-hand side of the alley. Whenever you have a few spare moments, practice this with just the 1-2-3-5 pins set up.

A word about the four styles of balls. On the straight ball, as I've already pointed out, control is no problem, as it is rolled without making any attempt to turn the wrist one way or another but with the thumb pointed straight at the 1-3 pocket. This style is particularly effective when delivered with sufficient force to hold direction.

The curve ball is released by the player from the center of the alley with a decided twist of the hand to the left at the moment of release. The curve is acquired by a right to left turn of the wrist, releasing the thumb an instant before the finger, and with a lifting or pulling-up motion of the latter. The curve ball is not widely used by top-flight players as it calls for not only a great amount of practice to control but uncommon judgment of angles and speed to meet alley conditions.

The back-up or reverse ball turns to the right just before reaching the pins, this being effected by the bowler giving a twist of his hand or wrist to the right, imparting a clockwise spin to the ball. When delivering the ball in this manner, point it to the left of the intended mark.

The greatest pin getter of all is the hook ball and for this reason is most widely used. A counter-clockwise spin, similar to that of the curve, is imparted to the bowling ball by the bowler with a quarterleft turn of the hand as it is rolled. The difference between a curve and a hook is that the latter is rolled straight down the

(Continued to page 144A)

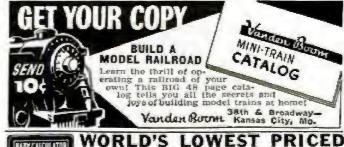




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(Continued from page 143A)

right side of the alley from a point close to the side with a sharp break into the pins rather than a sweeping curve.

After a time, many bowlers develop what they like to call "jinx spares." These are due to the fact they don't take advantage of the proper angles for their particular style of ball. Remember to use extreme angle on every shot wherever possible. Bunches or combinations 1-2-4; 1-2-4-8; 2-8 and 1-2-4-7 are bad spares and the most effective way of handling them is to hit them high or full, covering as many pins as possible with the ball. Such spares as 2-4-5-8; 2-4-5-7-8, and 2-4-5, with the same combinations on the right side of the alley. have a pocket the same as the 1-3 of a strike set-up. Such combinations as 2-8: 2-5-8, and 2-4-8 are considered difficult for any ball but usually can be made when hit full.

Single-pin spares, particularly No. 10, are a jinx to many players. The bowler who consistently misses it outside or inside is doing so because he's wrong on his angle for his ball. If he rolls across the alley from the left to the right only to see his ball skid into the gutter, he is taking too much alley and should move more to the center of the alley. If he always misses it inside, he should move more to the left of the alley.

The beginner will learn much through the medium of experimentation.

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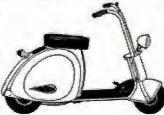
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The Fast Freight Rides the Hump

(Continued from page 357)

ductors of the various eastern and southern trains, while their pictures remain in the files, to be used as the basis for the Belt Railway's revenues. The yard collects \$5.86 for every loaded car passing through, \$2.90 for empties.

The forty-three-car train is ready for the hump. A powerful steam locomotive that often shoves 150 cars up this grade is coupled on the rear, ready for the big push. The humpmaster calls the order into the loud speaker, the signal changes from red to yellow—four miles an hour—then green, eight miles an hour, and the long string of cars starts the climb.

At the hump stands the conductor, train list in hand, directing the cut. At his command: "Cut one," the pin puller uncouples the first car, a load of lumber for the Wabash. It breaks from the train, gathers momentum as it leaves the hump and glides down into the Wabash track, No. 9. "Cut one." Lumber, again, but destined for the Pittsburgh, Ft, Wayne line. The towerman notes "EH" on the car list, indicating it is extra heavy, and as it gravitates toward track 34 he throws a retarder switch. Compressed air thrusts against pistons, lever arms press down, steel brake beams clamp like a vise against the car wheels. They grind to a stop as the track brakes tighten their grip under 100 pounds of air pressure. Then the towerman releases the air and the car slides on at a safe speed. Beyond the last retarder the tracks are all scientifically graded so that a car will roll at a constant speed of two miles an hour to the end of its assigned track,

Sometimes there is a crash on the retarder as a heavily loaded car rolls onto the brake section before the car ahead has started. But not often. An alert towerman can keep them traveling from the hump at nine a minute when there's a close connection to make—but if he's to avoid any crackups he's got to concentrate on cars and forget the sky liners skimming overhead on their way to the near-by airport.

When the car retarders went into operation a few months ago there was a critical labor problem to meet. These towermen who operate switches and retarders had to be experienced men, and there weren't any. PULAR MECHANICS ADVERTISING SECTION

The Belt line had to find some wide-awake fellows who could learn by practice how to judge a car's momentum from its weight, the effect of the prevailing wind and other factors; they had to know whether to apply the retarders in position one, two, three or four, representing air pressures from twenty-two to 100 pounds.

In the old days, when a car went careening out of control bound for a bang-up finish, there would be a whistle for help from the car rider and a skate boy would race across the maze of rails to intercept the runaway and shove an iron skate on the rail in front of it. The retarders have ended most of these emergencies, but some modern yards have automatic skates that flip into position on the rail at the touch of a remote button.

Cutting of cars at the hump goes on. Car No. 3, paper, for an industrial track, No. 54. Car No. 4, the re-iced pears for the Erie 7:05 train. The next two are headed for the same track, No. 43; the conductor at the shanty calls "Cut two," and the pin puller turns the pair loose, boxes for the New York Central and lumber for the Michigan Central. And so they roll, rye for the Monon, paper for the Panhandle, sugar for the Pere Marquette and Nickel Plate, salmon, butter, eggs, prunes for a dozen different lines east and south.

At 6:11 a.m. the last car breaks from the pusher engine, the hump is cleared for another string from the west. A train that used to spend eight hours to a day in dissolving and reassembling has been humped in little over an hour.

Four thousand cars a day, 125,000 a month, 1,500,000 a year flow east and west through the two main arteries of the Clearing hump and down into the capillaries that lead them to the main trunk lines again. The yard was designed to handle 6,000 a day. In a pinch it could handle | 8,000. Its record so far has been 5,236, but on one busy day 3,147 cars were sorted on the eastbound track alone. A wartime surge of traffic some day might bring another critical jam of transcontinental freight, but it will never be like the old days when car riders planted their feet on the rocky roofs of swaying boxcars, swung hard on the rusty brake wheels and hoped the electric speeders waiting at the end of the yards would bring 'em back alive.

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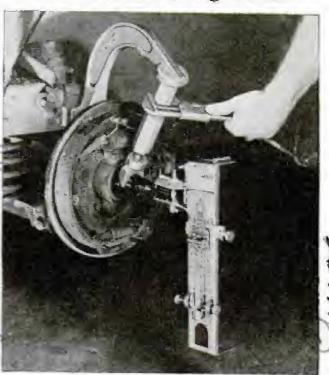


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New Metals from Powder

(Continued from page 323)

What makes the powder stay together? You might think it would crumble after removal from the press. Instead, a pressed and sintered object is as strong as if it had been cast. It may be machined like any other metal. The reason is not fully understood. One belief is that extreme pressure expels the air from between the particles of powder and that interlocking of the angular and irregular surfaces occurs. A certain welding action seems to take place, possibly from the heat developed during compression. Evidence of alloying has been



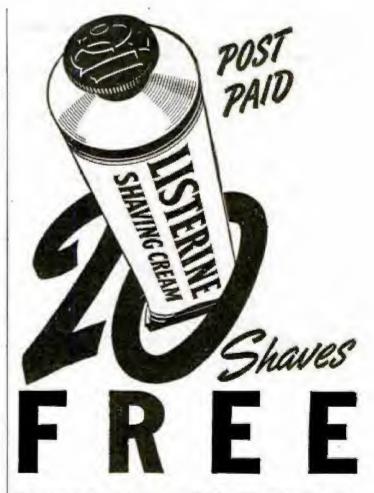
Lamp filaments with coils invisible to naked eye are inspected under microscope during manufacture

observed under the microscope, suggesting atomic migration from one powder particle to another. When desired, definite alloying is produced by heat and sintering treatments after an object has been molded in the press.

Young as it is, powder metallurgy already has found wide application. "There is hardly a modern American home that doesn't use self-lubricating bearings compressed from powder," says E. S. Patch of the Moraine Products Division of General Motors Corporation. "They are used in washing machines, refrigerators, ironers, mixers, fans, and automobiles. Even the casters under your chair are probably equipped with self-lubricating bearings."

The process got its start more than a century ago when some practical way was

(Continued to page 151A)



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(Continued from page 149A) 2 1 38

sought for producing ingots of such refractory metals as tungsten and molybdenum. These metals require extremely high temperatures for melting and they have unsatisfactory characteristics after they are poured. Oxides of the metals were reduced to powder and the powder was compacted into ingots, which were put through a series of swaging operations and heat treat ments. That solved the problem and this method of refining is still used for refractory metals. The tungsten filaments used in modern electric lights are a more recent development of the process, tungsten ingots being drawn through dies until reduced to the right diameters. For some small lamps the final diameter of the tungsten filament is one-tenth that of a human hair.

Powder metallurgy has made possible safer electrical switches, current interrupting devices, and electrodes by providing special mixtures of metals suited to the particular requirements of the electrical industry. Silver and molybdenum or copper and graphite may be united into mixtures that preserve the characteristics of each constituent, the last combination, for instance, serving as ideal current-collecting brushes in motors and dynamos.

Hard-cemented carbide compositions such as the tungsten carbide alloys and tantalum carbides, made possible by powder metallurgy, provide better tools and dies for cutting and working tough metals. For oil-well drilling, tungsten carbide is pressed into rods so that the material may be applied by electric welding to the faces and cutting edges of drilling bits, creating hard surfaces that wear more than four times longer than the best metals available Tantalum and columbium previously. compressed from powder, are gaining extensive use in the vacuum-tube industry. As many as six elements have been compressed into one homogeneous compound one example of multiple mixing being the permanent magnets pressed from powders of iron, cobalt, nickel and aluminum.

Another use to which the process is put is the creation of metal disks, sections of which are permanent magnets set in the nonmagnetic structure of the disk. This is done by pouring the right powders in their proper places in the mold.

(Continued to page 152A)



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(Continued from page 151A)

Some thirty metals are now available in powdered form. Few alloys have been reduced to powder although it is expected that some alloy steels and most of the common non-ferrous alloys can be adapted to powder metallurgy.

Advantages of the process include the fact that delicate parts can be formed to precise dimensions without necessitating subsequent finishing, that metals can be mixed in the exact proportions desired, and that impurities sometimes unavoidable in casting may be excluded. Special structural effects not possible by the melting and casting process can be obtained. Metals difficult to alloy together because of great differences in melting temperatures may be combined easily. Practically no material is lost or wasted in powder metallurgy and in some cases production costs are lower than other methods.

On the other hand powder metallurgy has its limitations. The process is limited to the production of fairly simple shapes and does not compete with die casting in that respect. So far the technicians have been unable to "press around corners." Limitations in the sizes of molds and presses make the process applicable only to the manufacture of small objects of not more than several pounds in weight. Ultimately much larger objects may be pressed although costs probably would be extremely high.

Today, bearings, bushings, brushes, brakes, medals, coins, welding rods, resistances, magnets, thermostats, and lamp filaments are only a few of the objects produced in large quantities by powder metallurgy. Frequently the process is the answer to problems that can't be solved otherwise, an example of which is the new metallic "sponge" used to filter fuel in the injection apparatus of General Motors Diesel engines. In every field in which the process has been tried out its value has traveled far beyond original expectations and it now seems to be on the eve of further wide commercial applications.

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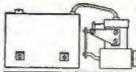
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Cameraman at the Front

(Continued from page 332)

through the bridges without doing real damage and exploded in the water.

From the bridge we proceeded to a hospital that had just been bombed. Five direct hits had been made by 500-pounders on the hospital and its grounds, blasting thirty-foot craters. I clambered into these holes, shot pictures from the second story of a ruined building near by, and then went into the hospital. Everything was in ruins, beds were covered with plaster, on one bedside table stood bowls of soup and half-finished plates of food, and one end of the building was shot away and you felt as if you were in a doll house with all three floors exposed. Next day I photographed another vast crater in the center of a street; luckily an air-raid alarm had sent everyone to cover, and no one was killed. Even the buildings on either side were scarcely damaged, for the main force of these explosions is upward.

This brings up an interesting theory from which you can compute your chances under bombardment. Even in crowded Warsaw, less than twenty-five per cent of the total area is covered with buildings; the rest is streets, parks, rivers, etc. Thus, of a thousand bombs dropped indiscriminately, only 250 would ordinarily strike buildings.

Just around the corner a 500-pounder pierced a five-story modern apartment. It looked as though a giant ice-cream scoop had slashed out the central section. Four-teen women and children were killed, twenty wounded. I photographed them. It was not pleasant, it was horror; but I was not making a travelogue, I was making an historical record on film of what happens in modern war.

Fortunately I had plenty of film, for supplies were at a premium. In a maternity hospital I had occasion to use the three photo-flood lamps I carried, photographing pathetic women with new-born babies resting on the tile floor of the cellar. And from there we went to the Eastman Kodak laboratory, still open, to have six rolls developed. At 4:30 the film was put in the developer and I started home. The mileand-a-half walk seemed endless, for the streets were now heavily strafed by small artillery, three, four-and-a-half and six-

(Continued to page 157A)







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(Continued from page 155A)

inch shells that did little damage to buildings but were timed to explode fifty to 100 yards in the air and spray hot steel on pedestrians. This turned out to be Warsaw's most terrible form of punishment, calculated to paralyze street traffic and end civilian resistance. Luckily, civilian France and England will be free of shell fire unless the Maginot line crumbles or England's soil is invaded. Bombs were bad enough, but when the German guns came close enough to shell the city we figured fifty to 100 shells exploded for every bomb dropped, and that 10,000 to 30,000 shells fell daily.

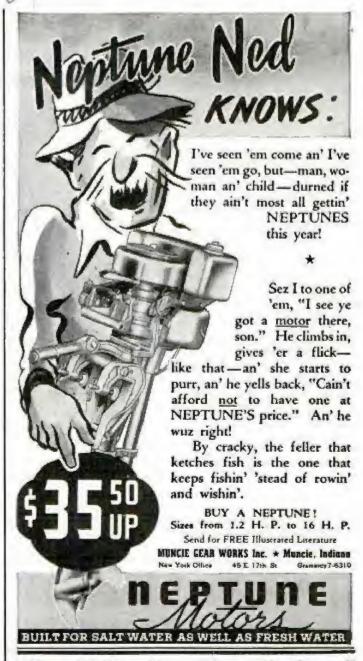
But to return to the kodak laboratory. The two Eastman men took my films out at five o'clock, put them in the hypo, and at 5:25 placed them in a tank of water. For a minute or two they left the room. While they were gone, at 5:30, a six-inch German shell made a direct hit, smashed the laboratory wall and ruined the developing tank. By an amazing stroke of luck the water tank six feet away was not touched. Most of the pictures appearing here were enlarged from those six rolls.

That night I waited late at the embassy for Thaddeus, my interpreter, and the car. At last there was a timid knock. Thaddeus came in, his arm bandaged, blood on a hole at the shoulder of his uniform. He was very apologetic about being late. The car had been hit, all four men injured, one probably fatally. After that we had to walk, carrying cameras and film.

A strange aspect of life toward the last was that, unlike most wars, soldiers and civilians were thrown much together. Front lines were just at the edge of the city, and soldiers came back each day to their families. Meanwhile civilians were busy digging trenches for the soldiers, sticking street-car rails into street pavements at an angle to block tank attacks, and building barricades. Despite bad organization it was amazing how spontaneously the entire population worked.

How does a city go on living, without shelter, with traffic paralyzed, with public utilities and supplies cut off? Next month I shall tell of my last days in Warsaw, of my interview with war prisoners, my escape across "No Man's Land" with my pictures to Germany, and flight from Germany to the United States.

(Concluded next month)



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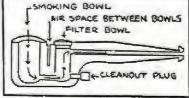
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Destroyer Versus Submarine

(Continued from page 351)

depth. One hundred feet. One-fifty. Two hundred. The engineer reported the engines had stopped. "Could they rest on the

bottom while they were fixed?"

No! Too deep! The cold black water would crush the boat. Two hundred and fifty feet! The diving officer reported headway was lost, the hydroplanes no longer acted. The game was up. Either they had to go down and be drowned, or rise and face the guns of those destroyers. Amberger chose the mercy of American sailors over that of the sea and ordered the tanks blown.

American tars were amazed to see the submarine's stern suddenly break surface at a sharp angle, settle back as the conning tower and the hull appeared. Quickly guns were remanned, shots were fired, the "Nicholson" hastily ran up and dropped a depth charge. Then out of the conningtower hatch crawled thirty men, arms upraised in surrender. Once again the strategy of the convoy had been proved.

Already in the current hostilities, Britain and France have reorganized the convoy system. Tonnage figures demonstrate that submarine warfare can cause losses and force the employment of hundreds of ships, thousands of men, to combat it, but

the easy hunting is gone.

First defense against the U-boat is the mine field, sown outside harbors where subs are based. Mines are laid usually at night by submarines and trawlers, protected by destroyers and cruisers. They sink few subs, these mines, for they are swept up almost as fast as planted by trawlers and drifters. But they hamper the U-boat's movements; for frequently it takes two or three days to get one safely in or out of harbor.

During the World War the British admiralty plotted on a chart the approximate position of every U-boat, frequently posting its number, and the name of its commander. This information came from Naval Intelligence agents at the very bases of the U-boats. And sweeping operations caused enough delay so this information could reach London in time to be of use.

After a sub broke clear, its own radio gave it away, for whenever the radio spoke, direction finders got a fix, promptly

(Continued to page 160A)

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(Continued from page 159A)

posted on the admiralty chart. Then, too, subs were constantly being sighted by fishing and patrol craft, or prospective victims. When a ship was attacked, its position was flashed before the victim plunged to its doom.

Then why weren't these U-boats sunk, if their location was known? Well, many were hunted down by plane and destroyer; but that is not so simple. It is one thing to draw a twenty-mile circle on a chart and say a submarine was there at 11:30 a.m. It is quite another to arrive in a destroyer two hours later and find that submarine.

For a sub can become invisible at will. On the hunt for prey, it cruises on the surface day and night, recharging the batteries on which it must operate when submerged. Lying low in the water, it can spot an enemy or victim ten to fifteen miles away, while it cannot ordinarily be spotted at farther than four or five miles.

But a submarine's invisibility ceases, temporarily, the moment it attacks. To use its deck gun, or board a ship to sink it with time bombs, it must come to the surface. The moment a torpedo is launched, the exhaust from its compressed-air motor leaves a telltale wake easily seen from a ship. The end of that wake marks the location of the submarine the moment the torpedo was fired. The submarine's speed, submerged, is only six to ten knots, so it takes an appreciable time to get very far from the end of that wake. On this fact the convoy system is founded. It forces the submarine to attack in the presence of swift destroyers, which can dash down that wake and sow depth bombs before the sub has time to get far enough away for safety.

The submarine cannot fight on anything like equal terms with a destroyer. Its narrow deck is a most unstable gun platform, making gunfire extremely erratic. A fishing smack armed with only a three-pounder has been known to defeat a U-boat, simply because the latter's crew could not make enough hits with its heavier gun before its fragile hull was riddled. A destroyer mounts heavier guns than a sub, and more of them; can move fast enough to select its own position and range, and can absorb many hits and still fight back. But any kind of a hit on a submarine will deprive it of power to submerge.

It is extremely difficult to torpedo a de-(Continued to page 162A)

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(Continued from page 160A)

stroyer, because of its speed, ability to maneuver, and shallow draft. A torpedo moves through the water under its own power-a compressed-air motor. A gyroscope and fins hold it on a straight course. It is set to run submerged at a certain depth, usually about fifteen feet, and has a mechanism for maintaining that depth. If it runs too shallow, wave action will deflect it; and the depth required to insure its running true is greater than the draft of a destroyer-hence it frequently would pass under such a vessel without doing damage. Even in smooth water, where the torpedo need not run so deep, the speed of the destroyer will protect it. For a torpedo runs only forty to sixty miles an hour and can be avoided if its wake is seen in time.

One American contribution to the antisubmarine campaign was the sub-chaser, with its hydrophones. These chasers, operating in threes, would patrol sub-infested waters, listening for the characteristic sound of the U-boat's propeller. Having heard it, each of the trio would note the direction, lines would be plotted to obtain a fix, and the speedy little craft would dash to the scene, obtain another fix, then strew the area with depth bombs.

In the World War, 100 allied subs sank twenty U-boats, a better batting average than any type of surface craft obtained. Sub against sub was not a case of the blind groping after the blind. Submarines must spend more time on the surface than submerged, coming up to recharge batteries, so they can run under water. A sub cannot stay under without its electric motors driving it forward, any more than an airplane can stay up when its motor stops. Once the motors stop, a sub must either fill its ballast tanks and sink to the bottom, or blow them, and come up. In enemy waters, its commander never knows when he will be forced to make an emergency dive, and a long, submerged run. Therefore he must strive constantly to stay on the surface, so his batteries will have full charge when needed. The defending sub is not in this constant danger; it may recharge batteries at night, cruise submerged most of the day, keeping watch through the periscope. It can thus see the rival submarine, with its conning tower and deck exposed, without being seen; can steal up and discharge a torpedo into the fragile side of its unsuspecting opponent.



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